THE

ELECTRICAL REVIEW.

VOL. LXII. JANUARY 17, 1908. No. 1,573.

ELECTRICAL REVIEW.

Vol. LXII.] CONTENTS: January 17, 1908. [No. 1,573.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEREAY, LONDON." Code, A B C.

Telephone Nos. Holborn 933; Central 4425 (Editorial only).

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FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

1908 EDITION
NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

LEONARDO DA VINCI AND OTHER MATTERS.

ALTHOUGH the past year was neither a centenary of the birth nor of the death of Leonardo da Vinci, there has in the course of it been a curious recrudescence of interest on the part of men of science in the life history of that great Italian. Some few months ago, as was mentioned in the ELECTRICAL REVIEW for November 15th last, Prof. T. W. Richards, in the course of a lecture delivered in Berlin, held him up to admiration as a man possessing the gift of imagination that is inseparable from the mental equipment of an investigator into the problems of nature, as a man, indeed, equally eminent in science as he was in art. Prof. Richards used language which, hastily read, might convey an impression that similar versatility is possible to-day; that the extreme specialisation, which not only sharply divides the man of science from the artist in line, colour, or words, but even separates the chemist, physicist, and electrician into various mistrustful sects, is as capable of removal as it is matter for regret. In all probability Prof. Richards had no such idea, but merely uttered a passing sigh for the good old days when no single branch of human knowledge was alien from the student of one. In the course of the highly interesting speech made by Lord Dunedin, whose title obscures the identity of a great Scottish lawyer, at the recent dinner of the Royal Society, held on November 30th, Leonardo da Vinci came into notice again. When proposing the toast of the evening, Lord Dunedin observed that although there was something very alluring in the idea of such a one, sculptor, painter, artist, maker of fortifications, being the foremost scientific man of his time, the day was past when the field of art, science, and knowledge of every sort, was so restricted that it was possible for one intellect to master the ambit of them all.

The day is past indeed. The day has come when it is hard enough for a man to keep pace with the advances made in two or three parallel branches of scientific investigation. As years go by, and knowledge grows from more to more, it is ever-increasingly difficult for a man to be a pioneer, to carry out successful research worthy of the name. The magnitude, often the very nature, of the difficulties escape the facile journalist and fluent political speaker, who refer glibly to things outside their comprehension. They have been taught that there were giants in the earth in former days, and now they tell their public that there are scarcely any mighty men of renown, in spite of our vastly greater facilities for teaching science and for performing research than were possessed by our ancestors a hundred years ago. To some extent assertions such as these are simply the result of ignorance—or rather, perhaps, of faulty perspective. Even his compeers seldom appreciate a man's personality at its full until after his death, and the like criticism applies with greater force to his life-work in science or in art. If

the vision of his equals is thus distorted by propinquity, the publicist, who forms his opinion concerning contemporaries at second or third hand, can hardly be expected to draw a fair picture. The non-scientific speaker and writer of to-day seem constrained to misrepresent facts; whether from pure malice, for the purpose of extolling other nations at the expense of their own, or simply without thought for the morrow in order to provide what the ignorant multitude regard as "good copy," we do not feel competent to decide.

In the olden days, when Leonardo da Vinci flourished, and even as recently as the time of Faraday, an intelligent, thoughtful man had only to take the shortest step on either side of the beaten track to come against some previously unnoticed phenomenon, to make some deduction hitherto unrecorded. Simple qualitative facts were welcome to the philosopher; a collection of them enabled him to formulate some theory immortalising his name. Now, although much, even an infinity, of work remains to be done, much has been accomplished already; and as the outposts guarding Nature's secrets are driven in ever so slightly nearer her impregnable citadel, her defences become stronger, require more energy and patience to break down. But, just as both in warfare and in scientific investigation an increase in the complexity or remoteness of the task to be undertaken demands a corresponding increase in the skill with which it must be performed, so also, both in science and in warfare, an increase in the complexity or remoteness of the problem to be attacked connotes an increase in the expense involved in solving it.

Faraday was able to carry out successful and valuable experiments with the aid of simple apparatus made by himself or purchased for a few pence, for which reason his discoveries appeal to the imagination of the layman; but the investigator of to-day is called upon to measure and to weigh with greater accuracy than even his immediate predecessor, and he cannot fulfil his duty without having recourse to apparatus every single item of which costs more money than would have sufficed to equip a whole laboratory a century ago. The precise utility of each expensive instrument used in existing laboratories can only be appreciated by a trained intelligence, and therefore the man in the street cannot be expected to realise the need for them. He naturally thinks that if the giants of the past won their heroic battles with javelin and sling, the effeminate warriors of the twentieth century should be satisfied with implements costing no more.

No doubt is felt by persons qualified to hold opinions on the subject, but that we produce youths competent to become great pioneers of science, and are able to train them to their work more efficiently than was possible in the past. The crux of the difficulty is a pecuniary one. There exist at the present date numerous agencies whose object is to assist research, but the funds at their disposal are so small that the sums awarded to individual investigators would appear ludicrous if they should not be more properly regarded as paltry. Lord Dunedin was only too correct when he said that the pitiful sums handed to various worthy persons reminded him less of aids to science than of what is called outdoor relief. Establishments are to be found, more particularly in the United States of America, where research is carried on as well as the education of students, many of which appear to be well provided with funds, to be actually wealthy; but they form nothing more than vanishing oases in the desert of unattacked ignorance, while the problems which are investigated there are by no means always those that most require solution.

Lord Dunedin said that nothing could be extracted from the Chancellor of the Exchequer but his blessing. We have, perhaps, settled down to accept that as the normal position to be taken up by the holder of the public purse. A different attitude on the part of the treasurer for so unscientific a people as Britons might enfold us in further difficulties, for rules and conditions might accompany grants, rendering them unacceptable. But we have not settled down meekly to bear the accusations of persons whose positions in life render their words of apparent weight when they allege or imply that men of scientific ability or even genius are no longer born in our midst. Such men exist; some of them are in posts where their attainments have full play; a few are happily in possession of private means, enabling them to prosecute research without thought of bread and cheese; but the majority are constrained by dread of the workhouse to restrict their energies to the supervision of workmen in factories, or to the cramming of irresponsive youth with unpalatable elementary scientific facts—youths who waste their teachers' time and the money of their parents.

Electric Bulk Supply.

The date of formation of the larger power supply companies is not so long ago that the memory of the arguments adduced by the pessimists at the inception of these schemes has entirely faded away. It was then argued that the electricity supply companies operating over a large area might possibly have some small chance of success if that area contained, scattered fairly uniformly throughout its length and breadth, a number of industrial enterprises requiring electricity for power purposes, but it was deemed impossible that they would ever tap the more densely populated districts which had already obtained and were working provisional orders for the supply of electricity for lighting as well as power. It was pointed out that the lighting load was in effect the backbone of any system of electricity supply, inasmuch as the price charged per unit for lighting purposes to a small consumer was very largely in excess of the rate at which electricity for power could be supplied in competition with rival forms of energy producers, such as steam or gas. It was, therefore, considered that the prospects for such large power companies requiring for their inception a large amount of capital in distributing systems were, at the least, problematic; and the fate of one or two of these companies, of which the South Wales scheme could be cited as an example, may have lent colour to this argument.

It was forgotten, however, that the argument of the "ring fenced areas" was precisely the same, on a more important scale, as that which once upon a time was brought forward as a reason why municipal supply authorities should not be able to capture private electric light installations already existing within their area. It was argued that the proprietary prejudice as well as the cost of the change-over would prevent business people from adopting the municipal supply if they already had a plant working, however inefficiently, on their own premises. Actual progress, however, in municipal supply has put this bogey to flight, and it is found that there is usually much less difficulty in getting a man who already has a private lighting plant to change over to a municipal supply, than it is to get a new installation installed or to effect a change-over from gas or steam.

The same process is working out in the case of the large power supply companies in whose areas are municipally owned electric light and power supplies. At first the municipal supply authorities were either openly hostile or watchfully dormant in relation to the more widely extended enterprise, but recent indications show that the municipalities are coming in. Some time ago, it will be remembered by our readers, the Newcastle-upon-Tyne Electric Supply Co., Ltd., entered into arrangements with the Tynemouth Corporation, who already had a fairly efficient supply of their own, to give them a bulk supply from their generating station at Carville. Shortly afterwards came the news that the Yorkshire Electric Power Co., Ltd., had taken over the lease of the electric lighting powers originally obtained by the town of Calverley. Recently the Cleveland and Durham County Electric Power Co. have made arrangements whereby a bulk supply of electricity to the Middlesbrough Corporation will be commenced in the course of the next few weeks, and they have also made an arrangement with the Hartlepool Corporation whereby the statutory powers of the Corporation are to be transferred to the company.

This sequence of events clearly proves that the tide of municipal antagonism towards the larger power companies is ebbing. There is no reason why this should not be so, as it is inevitably the case that, with the large generating units inducing utmost efficiency and the favourable diversity factor existing on their systems, the power-in-bulk supply companies can give a cheaper supply than can be generated by the smaller municipal stations, provided that the wise course is adopted of leaving the municipality to arrange its own accounts with small consumers, buying its electricity in bulk from the larger concern.

There is every reason why bulk supply companies and municipal authorities should work together in perfect harmony for the advancement of the supply of electricity for lighting and power purposes.

The Warner Truck.

Tramway traction is now so universally adopted in all populous centres, and employs such an enormous amount of capital in the aggregate, that any attempt to promote efficient operation must be welcomed by the tramway world generally.

In this light we view the successful results achieved by Mr. J. S. Warner with his truck, as demonstrated to many members of the technical Press on Friday last at West Ham.

The outstanding features of the Warner truck are now fairly well known; it was described and illustrated in the Electrical Review of September 7th, 1906, at which date both the West Ham and the L.C.C. tramway authorities were testing its capabilities, and it was through the courtesy of the former that we were able to gauge its merits last week. The Warner design allows of the fore and rear axles swinging independently about a king pin and accommodating themselves to the irregularities which exist even on the best laid track. Moreover, a flexible suspension is embodied which frees the car-body from minor lateral oscillations but controls its general direction.

To quote one of Mr. Warner's American friends, "The track cannot waggle the car."

Undeniably, the trial run demonstrated the comfortable travelling of the vehicle, which mainly affects the passenger; the independent lateral oscillations of the subtrucks carrying the fore and rear axles, and the steering action of the front axle, were plainly visible to those inside the vehicle—the car flooring having been removed—while the testimony of the West Ham tramway authorities that it saves 50 per cent. in flange wear is further evidence of its value.

Much as the running of a four-wheel car may be improved by this truck, we imagine that its application to long wheel-box vehicles will prove its advantages still further, as its first cost is approximately 20 per cent. less than that of bogies.

Wear and tear on tramway tracks and wheel tires is proving such a serious matter for average undertakings, that we shall watch with interest for further investigation by Mr. Warner into this matter in connection with his truck.

Teutonic Activity at Buenos Ayres.

As mentioned in this journal a few weeks ago, the German Transmarine Electricity Co., of Berlin, has sought to obtain an extension of the period of its lighting concession at Buenos Ayres, for 50 years. The Argentine capital has developed to a considerable extent in recent years, and now boasts of a population exceeding 1,000,000 persons. It has consequently been the centre of activity of a number of enterprising companies of external origin, but we believe all the electric lighting undertakings, English and otherwise, have now been consolidated in the hands of the German company in question, whilst at the same time the number of independent tramways has also diminished under Belgo-German auspices. The position at the present time is reflected by the fact that as the German company has now secured the prolongation of its lighting concession for 50 years, it has practically assured itself of a monopoly of electrical illumination for the next 10 years, if not for the whole of the 50 years. Indeed, the absorption of other undertakings and the possession of an incontestable monopoly for 10 years would appear to impart such strength to the enterprise at present, and in prospect, as to exclude the possibility of the introduction of competition on a commercial basis in future years. This assumption is all the more apparent having regard to the lengthy agreements which have been concluded with the local tramways for the supply of energy for the working of the lines for a term extending even beyond that fixed as the limit of the lighting concession, on the expiration of which the whole undertaking is to pass free of any expenditure into the hands of the municipal council. The basis of the new agreement with the municipal authorities is a reduction in the prices charged for supply to private consumers and the participation of the town in the profits realised by the undertaking. In 1906-7 the company furnished 65,000,000 KW.-hours, but only about 15,000,000 KW.-hours applied to private consumption, and the new agreement consequently leaves the company a hand which is largely free from limitation in regard to business premises, theatres, tramways, and in other directions. The company in any case appears to occupy a dominating position in the great Argentine city, and this has been achieved mainly as a result of the financial assistance which German banks—both the great banking institutions, and the others that are known as Industrial banks—are always willing to give to enterprises formed for the promotion of German foreign trade, and the use of Teutonic machinery in distant lands where there is prospect of a remunerative business in coast towns, even if the iron hand of the Navy should be ultimately requisitioned to secure the fulfilment of commercial obligations.

Electric Steel.—In *Electrochemical and Metallurgical Industry*, Vol. V, 3, the following account of the Roechling furnace is given. Induction furnaces have the following characteristic features: — There are no electrodes; liquid charges should be used; the heat energy is produced in the metallic bath rather than in the slag. One difficulty met with is that of charging the narrow annular crucible, and to overcome this the present furnace is built to tilt. It is carried on two bearings, and can be discharged entirely. It is possible in this type to remove the sulphur and phosphorus from iron to mere traces, and to maintain a liquid lime slag upon, and in most intimate contact with, the steel bath. The removal of large quantities of carbon is difficult if large quantities of phosphorus are present, but with 0·1 per cent. of the latter no trouble is encountered. With a small furnace the power factor is good, but with a larger type it requires improvement. To melt pig-iron in a furnace of 600 to 700 lb. capacity an alternating current of 50 periods, 385 KW.-hours per ton, was required. To complete a charge of scrap, 600 KW.-hours. This is by no means economical, and accounts for the use of molten metal. In the latter case, however, it is possible to refine the bath with a low expenditure of energy. Thus with Thomas steel it is possible to remove both sulphur and phosphorus and to recarburise the metal to 1½ per cent. and finish the charge with an expenditure of 150 to 200 KW.-hours per ton. To reduce the power consumption, the size of the furnace must be increased or the process carried through as quickly as possible.

D

HEAT-DISSIPATING VARNISHES.

By A. R. WARNES.

At the present moment electrical engineers are giving a fair amount of attention to the subject of heat-dissipating varnishes, and a few words on the composition and heat-dissipating properties of these preparations will no doubt not be without interest.

That a heat-dissipating varnish should be white, or nearly so, appears to be the manufacturers' idea of a perfect heat-dissipating substance. Now let us think a little on this subject. Are we not taught in physics that white compounds are poor radiators of heat; black being the best? Under the conditions in which these varnishes are used, it is required that the heat set up by the resistance of the copper conductor to the electric current be conducted to the surface of the insulation, and then radiated away. Now, as the conductor is surrounded by insulation, viz., cotton plus heat-dissipating varnish, the heat has to be conducted from the centre to the outside through the hardened preparation. As

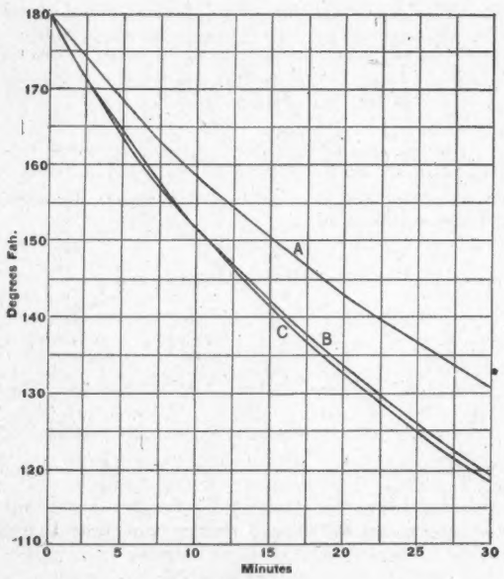


Fig. 1.

white compounds are poor radiators of heat, it seems hardly reasonable to expect the best heat-dissipating results from them. A very simple experiment which can be easily carried out by electrical engineers, if conducted with due care, will show that the white heat-dissipating varnishes do not possess any marked heat-dissipating advantage over the black varnishes, and what little they do possess is neutralised by several disadvantages. Before the experiment is described, it may be as well to say a few words on the composition of two well-known heat-dissipating varnishes which we will call A and B.

The varnish A is composed of boiled linseed oil, zinc oxide, and Russian turpentine. Varnish B is a rather more complicated mixture, the white base being china clay and lithopone (a mixture of zinc sulphide and barium sulphate), the binding material consisting of blown or oxidised cotton oil, and the solvent a mixture of coal tar naphtha and American turpentine. In the experiment about to be described, the varnish B was used, and for comparison an ordinary black insulating varnish. The latter was composed of best bitumen combined with oil, turpentine and specially refined naphtha constituting the solvent.

The apparatus used was of a very simple construction, consisting of a tinned iron cylindrical vessel, 10 cm. deep, and 5 cm. diameter, to the top of which was fixed a small wire handle, and a cover made of a thick piece of asbestos millboard. In this cover a small hole was made in the centre into which a Fah. thermometer was fixed, and another small hole was made near the edge through which passed the upper end of a wire stirrer. This completed the apparatus. In carrying out the tests, the apparatus was hung from a wooden peg projecting from the wooden arm of a burette stand; the apparatus, therefore, was completely surrounded by air. A place was chosen quite free from draughts, and the temperature of the surrounding air was taken. Boiling water was then poured into the apparatus to within 2 cm. of the top, and gently stirred until the temperature fell to 180° F. At this point the time was noted, the agitation continued, and the temperature read every five minutes up to half-an-hour. The first experiment was carried out with the object of finding the heat-dissipating value of the apparatus, the tin pot being thoroughly polished both outside and in. The result of this test is shown in fig. 1, curve A.

On the completion of this experiment the apparatus was taken to pieces, the pot dried, and then covered with one good coat of the black insulating varnish, after which it was stoved for six hours at 210° F. It was then allowed to cool down and stand over-night. The apparatus was rigged up next morning and the test carried out in exactly the same manner as described above. The result is shown in fig. 1, curve B. The black varnish was then washed off with a suitable solvent and the cylinder thoroughly polished. One good coat of the white heat-dissipating varnish (B) was then applied and stoved for six hours at 210° F. After the stoving, the pot was allowed to cool and stand over-night. The next morning the apparatus was rigged up, and the same test carried out as with the black varnish and the polished pot. The result of this experiment is shown in fig. 1, curve C.

Now, on examining the results of the three experiments, we find exactly what should be expected with regard to the polished cylinder, but with the black varnish and the white heat-dissipating enamel the results, on the face of it, do not seem to be quite in order, the result being slightly in favour of the white varnish, although from what physics teaches us we should expect the best result from the black. True the difference is not very great, but it requires some explanation. On considering the black varnish, we find that it is composed entirely of organic compounds, and that after stoving it has a brilliant surface. The white heat-dissipating enamel, we find, is composed partially of organic and partially of inorganic matter (mineral matter), and after stoving it has a dull surface. Now, organic bodies do not absorb heat so easily as inorganic bodies, and brilliant surfaces radiate heat in a lesser degree than do dull surfaces; therefore, the fact that the white heat-dissipating enamel contains mineral matter (inorganic matter) and possesses a dull surface, determines the slight increase in heat conducting and radiating properties over the black varnish. Had the black varnish contained mineral matter, say, black oxide of manganese, and stoved with a dull surface, the heat-dissipating property would have been in its favour.

As to whether or not a white heat-dissipating varnish should be used, especially when the heat-dissipating capacity is so slightly in excess of that of the black, this should not be decided upon without first considering its other properties. On inspecting the coat of this varnish on the tin cylinder, it was found to have wrinkled badly all over; this indicates that it shrinks, and a varnish which shrinks on stoving is not altogether the most desirable to use. Also, the fact that it contains mineral matter brings down its value as an insulator; a study of the various insulating materials shows us that mineral substances stand on the border line between semi-conductors and non-conductors. Another reason why it cannot be a good insulator is the fact that it is a heterogeneous mixture; the best insulators are homogeneous. On a further examination of the coat of white heat-dissipating varnish it was found to be very brittle, and this fact alone should not recommend its use.

The black varnish contains no mineral matter, and after stoving is much more homogeneous in composition than the white; for this reason it is a much better insulator. The fact of the bitumen which it contains being composed, to a large extent, of hydrocarbon bodies of the paraffin series also largely determines this property. The facts that the coat of varnish had not shrunk nor become brittle are also in its favour.

In the writer's opinion it would be better to leave the so-called white heat-dissipating varnishes and enamels alone

until greater advantages can be obtained from them. That a true heat conducting and radiating varnish is desired cannot be denied, but the insulating and flexible properties must not be allowed to suffer.

TEST OF A LOW-VOLTAGE ALTERNATOR FOR CALCIUM CARBIDE FURNACES.

A few months ago we noted that Messrs. Mather & Platt, Manchester, had in hand a 430-K.V.A. alternator for a calcium carbide works in Ireland, to the specification of Mr. Frank Broadbent, M.I.E.E., consulting engineer, and we are now able to give some particulars of the tests to which this machine was subjected. The normal output of the alternator was 50 volts 8,600 amperes, but it was stipulated that the machine should carry an overload of 10 per cent. continuously without a rise of temperature sufficient to injure the insulation.

The temperature rise of any accessible part of the machine was not to exceed 75° above that of the surrounding air during continuous working at the normal full load.

The efficiency asked for at unity power factor, including losses due to exciting energy, friction, windage and magnetic losses, was 92 per cent. The makers guaranteed only 90 per cent. under penalty, but fully expected to do 92 per cent. or more, and as will be seen from the result of the tests, they did much better than the guarantee. A further stipulation was that the self-induction of the machine should be such that no injury should result to it from a short-circuit in the furnace.

As it was not possible to test the machine on full-load at the makers' works, the following tests were agreed upon between the makers and the consulting engineer :—"The alternator to be driven at full speed by a separate motor, and excited to give full volts. The power required to drive it under these conditions to be taken as a measure of the iron,

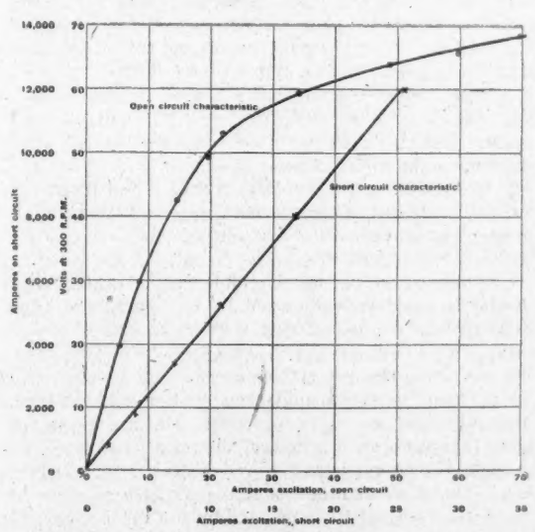


Fig. 1.—Open-Circuit and Short-Circuit Characteristics. Mather & Platt 430-kw. s.p. alternator, 50 volts, 8,600—9,460 amperes, 25 cycles, at 300 r.p.m

friction, windage, and excitation losses, the machine being excited from its own exciter. The current required for excitation for full voltage when running light to be measured and plotted vertically ; the current required for excitation to give the full main current when the alternator is short-circuited to be measured and plotted horizontally. The geometrical resultant of these two currents to be taken as the excitation current for full voltage on full load at unity power-factor ; and the energy required for excitation to be worked out accordingly.

"To these losses shall be added the copper losses in the stator, determined by a measurement of the resistance of the stator windings, and the sum of these losses shall be taken as the full-load losses of the machine.

"A test to determine the no-load characteristic of the machine, and a test to determine the short-circuit characteristic.

"The machine to be run on short-circuit to demonstrate that it will satisfactorily stand short-circuiting without injury."

In a machine of this nature it is essential to have a number of parallel circuits, and it is very important, therefore, that these should all develop the same instantaneous voltage, and run strictly in phase with each other. It is important, too, that any want of concentricity of the revolving field should not affect the above results. Before coupling up the parallel circuits, therefore, these were very carefully tested, and the voltages of the windings were found to be identical. To test the windings for phase difference, the ends were connected in parallel by a single copper wire No. 25 S.W.G., the fusing current of which is about 28 amperes. With full excitation this small wire got only perceptibly warm to the touch, so that the idle cross-currents were certainly less than 15 amperes. Table I gives the details of the short-circuit test, from which the short-circuit characteristic shown in fig. 1 was plotted. In Table II are found details of the open-circuit test, the characteristic curve of which is also shown in fig. 1. Table III gives the details of the open-circuit test of the exciter, the characteristic of which is shown in fig. 2.

The stator resistance was arrived at by measuring each of the parallel windings separately and taking the mean. The following are the figures of conductor and insulation resistance of the windings :—

Conductor and Insulation Resistances.

Alternator.

	Conductor resistance.	Insulation resistance.	High tension test.
Stator (10 circuits in parallel)	0·0000675 ohm	0·8 megohm	1,000 v.
Rotor winding	1·76 „	0·75 „	1,500 v.

Exciter.

Armature winding	0·227 „	0·5 „	1,000 v.
Magnet winding	9·6 „	7·0 „	1,000 v.

From the open-circuit and short-circuit tests the excitation for full load is arrived at as follows :—

Excitation for 50 v., 0 a., 300 r.p.m. = 19·6 amperes
„ „ 0 v., 8,600 a., 300 r.p.m. = 18·0 „
„ „ 50 v., 8,600 a. for p.f. unity $= \sqrt{(19\cdot6)^2 + (18)^2}$
$= 26\cdot6$ amperes.

This figure corresponds almost exactly with the calculated excitation for full load at unity power factor. The voltage on open circuit with 26·6 amperes exciting current was 56 volts, so that the rise of voltage from full to no load is about 12 per cent. Close regulation was not specified, and would be somewhat of a disadvantage for furnace work.

[copy.]

Tests made on 430-kw. Alternator for Calcium Carbide Furnace Work.

For F. Broadbent, M.I.E.E., Consulting Engineer.

50 v. 8,600/9,460 amps. 25 ~, 10 poles, 300 r.p.m.

TABLE I.—Short-circuit Characteristic.

Speed.	Amperes.	Excitation. Volts.	Excitation. Amps.	Exciter. Volts.	Magnets. Amps.
300	4,800	21	10	7	—
300	4,720	21	10	—	—
303	4,960	22	10·5	—	—
298	800	6	1·8	—	—
300	1,840	10	4	3·5	—
300	3,400	16	7·1	5	—
300	5,200	23	10·8	7·5	—
302	8,160	33·5	16·5	—	—
302	*8,000	34	16·8	—	—
315	12,000	51	25·5	17	1·7

TABLE II.—Open-Circuit Characteristic (Nov. 17th, 1907).

Speed.	Terminal volts.	Volts at 300 R.P.M.	Excitation.		Exciter mags.		Input to D.C. motor.		
			Volts.	Amps.	Volts.	Amps.	Volts.	Amps.	KW.
304	20	19·7	12	5·4	3·5	—	220	45	9·9
303	30	29·7	18	8·6	5·5	—	220	55	12·1
303	43	42·6	29	14·5	9·5	—	218	70	15·3
303	50	49·5	38	19·3	13	1·33	220	85	18·7
300	53	53·0	42·5	22·0	15	1·5	220	100	22
300	59·5	59·5	65·1	34·1	22·5	2·35	218	150	32·7
295	63	64·0	93	48·8	35	3·52	217	200	43·4
295	65	66·0	110·3	59·8	47	4·7	217	230	50
293	67	68·5	130·4	69·8	77	7·7	215	270	58

The efficiency was arrived at as follows :—

Total no-load losses, *i.e.*, input of motor	—	+ 19·5 KW.
Deduct no-load excitation 39 V. 19·6 A = ...	0·76 KW.	
Deduct motor and belt losses (measured)	3·50 KW.	— 4·26
Net iron losses		15·24
Add full-load excitation 53·5 V., 26·6 amperes.		1·43
Stator copper loss $(8,600)^2 \times 0000675 \times 1·15$		5·75
Full-load losses		22·42
Ful-lload output		430
Full-load input		452·42

Efficiency $\frac{430}{452·42}$ = 95 per cent.

The machine was not run at the makers' works sufficiently long to obtain the settled temperature rise, and this test will

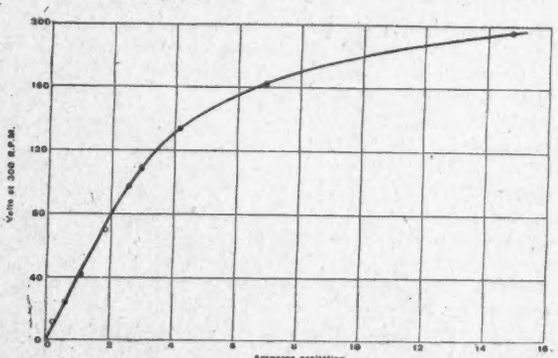


Fig. 2.—Exciter Characteristic, Open Circuit.

be made on site. After a run of about 1½ hours at 5,000 amperes, the windings were scarcely warm to the touch, and

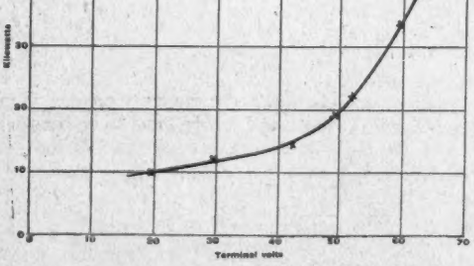


Fig. 3.—Curve of Total Losses on Open Circuit (Including Losses in D.C. Motor and Belt).

there were no signs of any local heating in the stator windings. We are indebted to the consulting engineer, Mr. Frank Broadbent, for the above particulars, the makers, Messrs. Mather & Platt, having consented to their publication.

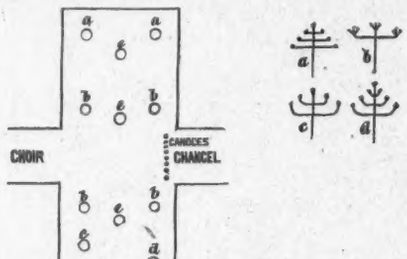
TABLE III.—Open-Circuit Characteristic of Exciter.

Speed.	Armature. Volts.	Excitation. Amperes.
300	11	0·22
300	25	0·60
300	42	1·10
300	70	1·80
300	97	2·56
300	108	2·95
300	134	4·15
300	162	6·9
300	196	14·8

THE LIGHTING OF WESTMINSTER ABBEY.

By CHAS. A. BAKER.

Many of those present in Westminster Abbey on the occasion of the funeral of Lord Kelvin must have been struck by the insufficiency, indeed the absolute poverty of the lighting arrangements. The day was gloomy, and artificial illumination was a necessity in many buildings throughout the metropolis, where ordinary daylight is given a fairer chance of creeping in than through the ornamental windows of the Abbey. It can only be looked upon as disgraceful neglect on the part of the responsible authorities that such an important place of public worship, attracting at all times one of the largest congregations in London, should be lighted by nine gas standards, fitted with five to nine burners each



c, 6-light wax candle pendants.

The Lighting of the Transept.

of such quality as appear to yield about 3 to 4 C.P. when working normally; some—not many—were flaring owing to some minute defect in the burners, and were, consequently, giving rather less light. I leave for the moment the lighting of the chancel and choir, which were not visible from the seats of group "C" during the time these few notes were made before the commencement of the service.

The standards deserve special notice, and in the above sketch are shown approximately their positions and the type. There is a pleasing variety in the design, which I interpret as evidence that at different periods in the history of the Abbey the internal illumination has received consideration. Down the centre are hung from the roof three clusters, each carrying six wax candles—these were not lighted on the occasion in question; they are neat in appearance, the glass globes are kept scrupulously clean, and as a standby source of lighting to enable people to find their way out, these chandeliers might be allowed to remain; but the gas standards—how any self-respecting authority can ever have permitted such monstrosities to have been put in, or having been put in to remain there for a day, is beyond comprehension—any first-year apprentice would bend up the small piping across his knee to the shapes represented, and, with a few three-way and four-way sockets, construct any of the patterns adopted in two to three hours. As to whether such standards should be of intricate, elaborate or plain pattern, is a question which, perhaps, ecclesiastical dignitaries might wish to decide, or at least to be consulted upon, and to have their views followed in the matter; but once the pattern

was selected, the workmanship and material should be the best of their kind for a building of the importance of Westminster Abbey, not of the sort that would be condemned as unfit for use in a third-class waiting room of the railway lines running south of the Thames.

Improved standards would not, however, be sufficient to do what is necessary to bring the lighting of the Abbey up to such a "standard of illumination" as reasonable people, whether attending the Abbey to worship or to inspect its magnificent historical monuments, have a right to ask. In the present century, eyes have become accustomed to more liberal lighting, and cannot with comfort discern the printed matter on a leaflet or hymn book, or the inscription on a tomb, under the wickedly bad light which is at present arranged. What are known as bat's-wing burners are still employed, but both wings are missing, and only something the size of a bat's body remains to pollute the atmosphere and pour out a continual stream of carbon particles which eventually find a resting place on the stonework of the structure, far in excess of any lighting effect which they are intended to produce.

The transept is now lighted, as stated above, with nine standards, each fitted with five to nine burners, actually a total of 69 burners; I suggest that each burner represents 4 C.P.; they certainly would not measure 5, and I do not think that they would much exceed 3. Thus there is an effective illumination of 276 C.P. in an area measuring about 190 ft. × 30 ft., or, say, 5,700 sq. ft. In a clean new building with some reflecting surfaces as boundaries, $\frac{1}{2}$ C.P. per sq. ft. produces a result that will usually pass without severe criticism; one-half of that amount, or $\frac{1}{4}$ C.P. per sq. ft., usually leaves many badly-lighted spots, about which somebody complains, but in the Abbey, where the surfaces roundabout do not lend themselves to reflection, the figure is less than one-twentieth of a candle power per square foot, and consequently the result is contemptible, utterly out of keeping with the requirements of a congregation wishing to use the Prayer Book, Hymn Book or Bible, and distressing to those who visit the Abbey for purposes of interest and education.

The effective candle-power should be brought up to something like 3,000 to 4,000, having regard to the surfaces of the walls and pillars, say, by 20 electroliers—10 on either side—each fitted with six Osram or tantalum lamps of about 30 C.P. A good effect would probably be obtained with arc lamps high up in the roof if any means of retrimming them is possible, or some inverted arc lamps with over-reflectors, the lights being completely hidden, would possibly produce a good floor illumination and a pleasing light by which the decorations of the building could be viewed.

Is it the question of first cost or running cost that has, up to the present, been the governing factor in the retention of the worst system and arrangement of lighting in any important public building in London, or is such retention due to the inability of the officials in charge of the arrangements to keep in step with public requirements? If so, may they look at it from the point of view of the preservation of the building, and of the decorations of the building. From every aspect a bold improvement is eminently necessary.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Limits of Municipal Engineers' Authority.

Being a contractor of many years' standing, I have recently had an experience in connection with an extensive installation, which makes me wonder whether there is any limit to a municipal engineer's authority over the wiring contractor.

I myself prepared and submitted a specification and tender for the work, which was accepted by the purchasers, through their authorised agent, and later work was commenced upon the installation.

After some weeks had elapsed, I was more than surprised to hear from my foreman that the electrical engineer's representative had paid a visit to the site, and demanded the opening-up of a considerable amount of finished work for his inspection. Naturally, my men objected to this unnecessary waste of time without my permission, the outcome of which was that I received a communication from the Engineer's Department, in which they made uncalled-for charges. Personally, I claim to have a sufficient knowledge of the work I undertake, which, in every case is tested at completion, and in no instance has connection been refused.

I also consider that, providing the contractor obtains a satisfactory test at completion, the supply authorities cannot refuse to connect the installation; and, moreover, unless acting by the consumer's special request as consulting engineer (which in this case was not so), they should in no way be allowed to interfere or dictate to those who most likely, by everyday experience, know more than central station engineers.

I may add that the work in question was carried out in accordance with the Institution rules. I should be glad to have other contractors' views upon this matter, which, if permitted to continue, will certainly make the contractor nothing more than practically a wireman, or one who is not allowed to make use of his training or brains.

Contractor.

The Use of Ball Bearings on Electric Motors.

We have read with considerable interest the able article on "The Use of Ball Bearings on Electric Motors," in the current issue of the ELECTRICAL REVIEW. There are, however, one or two points to which we should like to refer.

In the first place, it is stated that there are two principal types of ball bearings, in one of which the balls are kept apart by individual spring separators, and in the other by means of a cage.

Your contributor then gives a decided preference to the latter variety, for the reason that there is nothing to get out of order. This drawback is more imaginary than real, as these bearings with spring separators to which he objects were the very type employed on the dynamos, line shafting, ventilators, &c., he had previously cited as successful applications of ball bearings.

On the other hand, the fact is overlooked that all the cages on the market, with one exception, are composed of several pieces, generally of two parts, held together by means of screws, rivets or clips, and it is just these latter which cause trouble, as there is a constant tendency to force the halves of the cage apart.

In recognition of the demand for a simple and strong cage, a new D.W.M. ball bearing was placed on the market early last year, and this is the exception to which we have just referred. In this bearing, of which we enclose an illustration, the cage consists of a single bronze casting, thereby making the bearing the simplest and most reliable on the market.

Turning to the question of thrust on radial bearings, we should like to point out that thrust bearings are far from being essential in all cases, especially where the thrust is not considerable, and where high speeds are concerned, as, for instance, in electric motors (horizontal); furthermore, the axles of the majority of motor cars are unprovided with thrust bearings, and end loads are certainly present, if more or less occasional. Where end loads have to be considered, a great deal depends on the design of the bearing itself, and particularly the races, while the size is another very important consideration.

For **Ludw. Loewe & Co., Ltd.,**
W. S. DAVENPORT, *Managing Director.*

London, E.C., *January 11th*, 1908.

Although readers of the ELECTRICAL REVIEW have to thank the writer of your article on "Ball Bearings" for some very useful information, there are some points well worth consideration.

The arguments put forward in favour of ball bearings are rather curious in some ways. No. 1 advantage claimed is, to say the least of it, very amusing. Motors which are manufactured in hundreds are from ¼ to 6 H.P., and the reduced cost of packing would hardly be 2d. Why, it would hardly pay for the split pin or grub screw through the shaft end.

To a certain extent the second argument is correct—that is, as far as concerns the wear of the bearings. I must admit the life of Hoffmann and Ludg. Loewe's ball bearings is very long, and is a very good feature. We are informed under heading No. 2, that the balls used may vary from (say) ¼−·00002 in. to ¼+·00002 in. This means that of four consecutive balls the first may be ¼+·00002 in. in dia., and the next three ¼−·00002 in. in dia. The weight of the rotor or armature would then be carried for part of the revolution ·00002 in. high, and for another part ·00002 low, or a variation of ·00004 in. In induction motors the magnetic field is very great, and, when fitted with ball bearings, this slight variation, coupled to the fact that there is such a short bearing surface, may cause the rotor to sag a great deal. Several things may result from this. The shaft may become fatigued, crystallise and break. The balls may start grinding, and very little will make them break, or flat them. If fitted with thrust a very likely result would be considerable heating. (This fault would, of course, be put down to the motor.)

I wonder what firm can make a satisfactory job of two or three hundred brackets which are bored $\frac{1}{100}$ in. out of centre. Most bearings take the form, in small machines, of bushed brackets, and it is going to be expensive to have to shift every bracket $\frac{1}{100}$ in. to get the right centre height.

The advantage claimed under No. 3 heading is not fair. If standard shafts had proper oil flirts or flingers turned, and wipers fitted, a great deal of the obnoxious oil throwing could be done away with. Ball bearings are required to run in grease which, on heating and churning, would prove equally offensive if no special precautions were taken in the way of wipers, &c.

The advantage claimed as regards efficiency is not very great. A customer who wants a machine for general use, and *cheapness*, would hardly think twice in choosing between a motor fitted with good standard bearings at 88 per cent. efficiency, or a motor with expensive ball bearings at 89 per cent. efficiency. Your author seems to have an idea that the cost of fitting ball bearings to a machine is very trivial; does he take into consideration the work in connection with the special shaft, which has to be shouldered, coned or screwed, &c.? Also the special castings required in the way of bearing brackets, caps for protection and grease holding, clamp rings, &c.? Manufacturers will not stock these special parts, on the off chance that a customer will call for ball bearings in a small motor.

The thrust question is of greater importance than your contributor seems to think. When ball bearings are fitted to electric motors, a lot of special work is entailed during erection to obtain satisfactory results. The machine has to be temporarily erected, run up, and the magnetic centre found. The bracket has then to be machined to suit each magnetic centre.

Assuming that labour is not a great consideration (although it is), one point must not be overlooked, and that is the interchangeability of component parts. The last consideration alone would make a customer very careful in choosing a ball-bearinged motor. This applies to both large and small buyers and users. The small user knows how handy it is to take off a hot bearing and slip on one from a machine which is not being used. What happens if the magnetic centres vary $\frac{1}{8}$ in. to $\frac{1}{4}$ in.? It soon does away with that 1 per cent. extra efficiency.

Again, looking at it from the customer's point of view, when he has paid a good price for a ball-bearing machine, he expects some saving in running expenses. Does he get this saving? An expert in ball bearings must always be at hand, or otherwise such flaws as grinding, broken balls, heating, &c., would soon make it necessary to have a new set of ball bearings.

As regards fig. 2, your esteemed writer has forgotten one point. If a pulley is wanted which has to cover the bearing, where does lubrication come in? Is he going to have a pipe fitted to his bearing and grease supply? All this means more expense, and, oh! what a thorn in the manufacturer's side.

Again, ball bearings are made so nearly theoretically correct that very little scope is left wherein the unskilled attendant may attempt to rectify faults. What scope there is left should only be trusted to a very skilled man.

For line shafting and vertically-arranged shafts, I admit ball bearings are very good.

It is only fair, in conclusion, to thank your writer for some useful tables, and the trouble he has gone to in describing the methods of running and fitting ball bearings.

S. M. G.

Birmingham, *January 13th*, 1908.

Detrimental Circulars.

I have received from Messrs. The British Arc Lamp Co. a very interesting circular in which they point out that the cost of running their 4-ampere arc lamps *at* 1½*d. per unit* is only £2 16s. per 1,000 hours, whereas high-pressure gas lamps cost £4 6s. per 1,000 hours. It is left to the reader to infer that at 4½d. per unit—the average price of lighting by electricity—these interesting lamps will cost only £8 8s. per 1,000 hours, as against £4 6s. for high-pressure gas.

I beg to remind Messrs. The British Arc Lamp Co. that certain famous German carbon filament 10-watt-per-C.P.-with-no-name lamps will at 0·0002d. per unit knock spots off inverted gas at 16s. per 1,000 ft.

A. J. Abraham,
Electrical Engineer, Lanark County Council.

Cambuslang, *January 11th*, 1908.

Wireless Telegraphy.

Mr. Hall's letter, which appeared in your issue of November 29th, does not, I think, call for any reply. The readers of the ELECTRICAL REVIEW are probably sufficiently well aware of the manner in which Sunday editions are made up and telegrams expanded.

From the number of congratulatory letters the writer has received from eminent electricians, it seems evident that the writer's efforts to bring about a reform in the matter have been approved, and the only adverse criticism which has been called to my attention is one appearing in the *Times* of November 27th.

In regard to this it will be sufficient to point out that one of the messages given in my previous communication as having been repeated six times during a period of several hours before its receipt was acknowledged, was one addressed to the *Times*. The statement of the *Times* was doubtless made in good faith, but merely indicates that the *Times* has no means of knowing what the facts of the case are.

As regards my supposed reasons for being disappointed at the transmission of messages during daylight, I can only say that the writer of the criticism has the advantage of me. The facts are as follows:—

The Marconi Co. and its engineers have always held that daylight absorption was greater with long wave lengths than with short. For example, Dr. Fleming in his book, "The Principles of Electric Wave Telegraphy," p. 618, after giving a long mathematical proof of this, makes the following statement:—

"*Accordingly*, the chief part of *the weakening of the wave by sunlight* is done in the neighbourhood of the sending antenna, where the magnetic force H is greatest, and it *is more sensible for long and powerful waves than for short and feeble ones. This agrees with the observations of Mr. Marconi.*"

The writer, after conducting a series of very costly experiments extending over four or five years, discovered that neither of the above statements was correct. I demonstrated first that the weakening did not take place in the immediate neighbourhood of the sending station; and secondly, that though the absorption increased with the wave length up to a certain point, above that point it decreased very rapidly, so that for frequencies of 75,000 or less there was com-

paratively little absorption. These conclusions were proved by working in daylight from Brant Rock to various islands in the West Indies, and as the distance was practically the equivalent of that between Ireland and Newfoundland, and the receiving station was in the tropics, and the experiments were conducted in summer, the test was a very much more severe one than any test between Europe and America.

As these discoveries have been protected by patent applications, the writer is at loss to know why Mr. Marconi's very interesting confirmation of the fact should be anything except highly gratifying.

As the *Times* article misrepresents my position, I would like to make this plain.

I will begin by quoting the following statements :—

"London *Daily Mail*, September 26th, 1907.
"Atlantic Wireless, Cheaper and Quicker than the Cable.
"(From our own Correspondent.)
"Sydney (N.S.), Tuesday, September 24th.

"In my interview with Mr. Marconi to-day on the inauguration in three weeks' time of the wireless trans-Atlantic service, the inventor said :—

"*The weather will have no effect on our work unless our poles or masts should be damaged. Lightning will not bother us at all.*

"*At present we send 20 to 35 words a minute, but we could work much faster.* We have made no effort for speed. I shall send the first commercial wireless message myself, and after the station is opened shall remain here for about a week. The annual meeting of the shareholders will be held in London in a few days.

"I should not be surprised if the cable companies reduce their rates. It will be a good thing for the public. I shall charge 5d. a word for private messages, and 2½d. for Press work.

"We are working day and night to bring our plans to a successful issue, and *I give you my permission to say that in less than a month the Marconi wireless system will be working as smoothly, and with as much perfection as its elder brother, the cable.*

"'*Trans-Atlantic messages,*' he added, '*cannot be intercepted by ships at sea.*'"

"*Boston Herald*, October 19th, 1907.
"Sydney (N.S.), October 18th, 1907.

"*Yesterday we transmitted* 13,000 *words by wireless across the ocean to Europe, and received* 2,000 *words in return from the other side*, was the statement Marconi made to-day of the result of the first day's working of the wireless trans-Atlantic service.

"What time do you estimate would be required to cover a return message to London ?

"At present not less than two hours. This is due to slow deliveries. We can transmit a message to Clifden, and get a reply in three minutes, and *out of the large number of miscellaneous messages sent yesterday*, not one word had to be repeated."

My position is, that the statements italicised above, also the statements made by the Marconi Co. with reference to the receipt of signals in Newfoundland in December, 1901 ; the statement that the Anglo-American Co. objected to the continuance of those experiments ; the statements made with reference to the transmission of the President's message in January, 1903, and numerous other statements made by the Marconi Co., are incorrect and misleading, and have seriously hindered the development of the art of wireless telegraphy, and have tended to bring the whole subject into disrepute.

R. A. Fessenden.

Brant Rock, Mass.,
January 2nd, 1908.

Socialism and Industry.

Mr. Ben Frank, in his article in last week's ELECTRICAL REVIEW, mentions the Newcastle-upon-Tyne Electric Supply Co. as only paying £11,400 in 1902, as against £74,000 in 1907. He quite leaves out the question of the capital of the company. The Newcastle Co. have paid 8 per cent. now for a good number of years—if my memory serves me right, as far back as 1897. It is absurd to talk of 1902 as a lean year. The company have done pioneer work as regards bulk supply. But in the old days before 1902 the men had a bonus system in vogue, and every man had a chance of becoming a shareholder. It is time now that men who have to earn their living in electrical work should speak up against those who flood the market with a crowd of young men poorly paid, as our big power companies are doing.

Ten Bob a Week.

Review of a Review.

With your permission I should like to make a few remarks on the most interesting and careful criticism of my "Handbook of Wireless Telegraphy" which appeared in your issue of January 3rd.

While I am grateful for some of your reviewer's criticisms and for the evident care with which he has read the book, I think it was a mistake for him to attempt the impossible in trying to remove from my mind what he considers to be my misapprehension as regards sounding and recording receivers. If he had been a telegraphist, he would have known that in all high-speed telegraphy recording instruments are necessarily employed, since it is physically impossible to read by sound at speeds above 35 or 40 words per minute. Thus the present wireless speed record of 90 words per minute between Hunstanton and Skegness could not possibly have been read by sound. He would also have known that it is often possible, by careful scrutiny of an imperfect record, to read a message correctly which would have been unintelligible to the ear. His statement as to there being no rule requiring the repetition of postal telegrams containing code words is directly contradicted by the last sentence of Sec. 6 on the back of an ordinary Inland Telegraph form, which says that such telegrams "ought always to be repeated."

It was somewhat hasty to assume that my statement regarding the type of wave given out by an untuned Marconi transmitter ("plain aerial") was a mere re-echo of what had already appeared in text-books, for, as a matter of fact, it is the other way on. It was I who, in 1898, made the first experimental measurement of the damping in this type of transmitter. I found the coefficient to be approximately ·6, which gives, as I stated, about three or four effective waves in each train. It is probably my result which has been re-echoed by the text-books, not *vice versa*.

I am much interested to hear that the current in Schaefer's anti-coherer amounts to "a number of milliamperes." I have seen no actual figures, but should have thought that one ten-thousandth part of a milliampere would have been nearer the mark. I should be much obliged if you would refer me to any data on this subject, as I may have to revise the paragraph in the second edition of my handbook, which will appear in the course of a few months.

I have not any very recent figures in regard to the Armstrong-Orling system itself, but with a very similar conduction system telephonic speech has actually been transmitted 7 km. with a base of only 450 m., which fully justifies my statement that the ratio of range to base-line in conduction systems has been enormously increased (see ELECTRICAL REVIEW, No. 1,263, 1902).

There is not space to discuss theories of transmission here, but I may point out that in Prof. J. J. Thomson's experiments on the electrodeless discharge, the gas was not previously ionised ; and that he has shown that there is a critical pressure at which the gas suddenly becomes conductive ; that the experimental results of such capable physicists as Prof. Fessenden point directly to the existence of an upper conducting layer in the atmosphere ; and that finally my own view of transmission does not essentially include reflection, but merely recognises the existence of this upper layer, which *may* reflect if its surface is smooth and sharply defined, and *must* to some extent absorb.

I omitted the mathematical discussion of coupling because I was aware of the unsatisfactory nature of what had at that time been put forward as mathematical theory. There was such obvious disagreement between the best conditions as deduced from practice, and those indicated by so-called theory, that one simply could not quote the latter. My decision has been amply justified by subsequent work.*

Again thanking you for your careful and thorough criticism, which is of far more value than a mere review.

J. Erskine-Murray.

London, W.C., *January 9th*, 1908.

The remarks by Dr. Erskine-Murray on the review of his book, while framed in a courteous manner, are not calculated

* See for instance, M. Wien, *Phys. Zeitschr.*, VIII, p. 764 October 24th, 1907, who shows that accepted theory involves errors of as much as 30 per cent. ; and C. Fischer, *Ann. d. Physik* February 5th, 1907.

to strengthen his position. The points raised will be dealt with *seriatim* as briefly as possible.

Recording instruments are, of course, used for receiving from high-speed telegraph transmitters, but a far larger proportion of circuits are operated at key speeds, and where there is any choice in the matter sound-reading receivers are preferred, as stated. It may also interest him to know that it is *not* physically impossible to read by sound at speeds above 35 or 40 words per minute. As a matter of fact, over 50 words per minute can be read and understood. Transcribing them to paper continuously at this rate is, however, quite a different matter. Referring to the speed of 90 words per minute between Hunstanton and Skegness on wireless apparatus, he remarks that a sound-reading receiver could not have been used. Quite right! It wasn't. But that is beside the point raised, as is also the question of scrutiny of bad signals on slip. If Dr. Erskine-Murray will look again at the back of a telegraph form, he will, perhaps, gather that the advice as to repetition of code messages is to the sender (that is, the *originator*) of the message, and that he is required to pay extra for the repetition.

With regard to the damping of waves emitted by a "plain aerial" transmitter, I will not attempt fully to discuss the matter here, but content myself with one further criticism which may appeal to him. He says that his original measurements have shown that the damping coefficient is approximately ·6. Good. But even if this were so for the particular transmitter used (which I take the liberty of doubting, if the test was made on a station of moderate range under working conditions), surely he will not argue that it is so for all stations with plain aerial transmission independently of height and capacity of aerial, number of wires used, &c. More than one modern system may be described as "plain aerial" type, so far as the transmitter is concerned, and I am content that the owners would not agree that the damping coefficient is anything approaching the figure quoted by Dr. Erskine-Murray.

I am sorry I am not able to oblige by giving a reference to any published figures on the subject of Schaefer's anti-coherer, but the experiment can easily be tried (if a razor and *not* a diamond is used to divide the silvering). The applied voltage, however, is not, I find, 3 or 4 volts as mentioned in the review, but from 1 to 1·4 volts, which, of course, makes the electrostatic effect even weaker.

The "enormous" increase in range achieved by the Orling-Armstrong system need not be discussed after the figures supplied by Dr. Erskine-Murray, as results of a similar order were obtained on the old-fashioned conduction system before the Armstrong-Orling was heard of. The figures given, by the way, cannot be traced in the reference furnished by him.

I think Dr. Erskine-Murray must have misread J. J. Thomson's experiments. Probably the critical pressure referred to is electrostatic stress, not gas pressure. Anyhow, if he considers it worth while, perhaps he can furnish a specific reference.

That the mathematical discussion of coupling is incorrect is admitted, and I could give an earlier reference than either of those furnished, but I fail to see that this is sufficient excuse for disregarding the existence of so important a principle as the interaction of resonant systems and its effect on tuning.

The Reviewer.

January 14th, 1908.

Gas v. Electricity.

I was considerably edified in reading the letter by Mr. Sydney F. Walker, of Bath, under the above heading, in the Electrical Review for January 3rd. It is very evident to me that he treats the matter as from the point of view of the gas man. He must remember that when comparing the costs of our two illuminants, he must liken the cost of the ordinary electrical incandescent lamp to the ordinary fish-tail gas burner. He must not compare the electrical incandescent lamp to the incandescent gas mantle. If he is comparing this he must put it up against an arc lamp. If he does this, he will find that for cost per candle the electricity works out far and away cheaper than its unhealthy rival for light, while for heating and power it is the best, being cleaner and less cumbersome than either a gas stove or a gas engine with its loud and irregular exhaust. In conclusion—why do gas fitting manufacturers make their fittings as near as possible to resemble electric lamps, arc lamps, &c.? Because "Imitation is the sincerest form of flattery!"

Unconvinced.

Heating Water for Baths by Electricity.

On p. 48 of your current issue reference is made by Mr. Wilkinson to the cost of heating water by electricity, which suggested to the writer that if it were feasible to heat water for baths a very desirable load could be procured, and one that would not overlap the lighting load. Again, the cost of installing hot water baths is considerable, and their working very inefficient, due to the losses of heat going on night and day. Would some of the manufacturers of electrical heating apparatus please give particulars of what can be done in this matter and cost of same?

A. B. C.

Want of Enterprise on the part of British Firms.

When changing residence last spring I sorted out my price lists, catalogues, &c., retaining only the latest issues. These were, by a strange blunder, again mixed with the scrap heap and destroyed.

In your issue of June 28th I advertised for price lists covering all business with which I am in touch, and received one complete set from a large British firm, one foreign mining catalogue, and about half-a-dozen relating to fittings and specialities. I have twice been in town, and find firms very loth to give either catalogues or information unless for *bona fide* sales. Without something to show clients it is difficult to do business.

Engineer.

The City Lighting and Measurement of Illumination.

Mr. Haydn Harrison's note in your issue of December 6th, and Mr. Kenelm Edgcumbe's letter appearing in your issue of December 20th, open out a very interesting question as to the proper method of measuring illumination. Since engineers have clearly understood that the term "candle-power" is something that can be juggled with, and used to mislead instead of to enlighten, the measurement of illumination on the principles laid down by Mr. Trotter in his paper read before the Institution of Civil Engineers in May, 1892, is becoming general. Mr. Trotter has spent a great deal of time, thought and ingenuity in producing his delightfully simple form of universal photometer, which can be used for measuring either illumination or candle-power, since the photometer screen can be set at any angle.

Mr. Trotter pointed out in his classical paper that, for ordinary purposes, if illumination on a horizontal plane was satisfactory, illumination on a vertical plane was better. The measurement of illumination on any horizontal plane below the lamps themselves takes account of illumination from other sources, whether direct or by reflection, with the exception of light reflected from the ground. The measurement of illumination on any plane other than the horizontal practically excludes all the reflection from the ground, and also partially excludes direct or reflected light from other sources than the one to which the screen is normal, or nearly normal. The amount of light excluded from another source will depend on the position of the photometer.

Mr. Harrison's method of measurement was brought out, I believe, with the view of measuring rather feeble street illumination, the system of placing the screen normal to the rays of light, or at a fixed angle of 45° to the horizontal, making it more easy to measure low illuminations. I could never see any other reason for this method than the difficulty of measuring very feeble illuminations, and it is surprising to see this method suggested as a satisfactory measurement of illumination where the minima are so high as to be readily, and very easily, measured on a horizontal plane.

The weakness of Mr. Harrison's method, by which lights from another source than the source exactly opposite the photometer are largely, but not consistently, excluded, can be illustrated by the illumination curve shown in Diagram No. 1, taken between two Oliver arc lamps and along a line vertically below them, with a current of 9 amperes

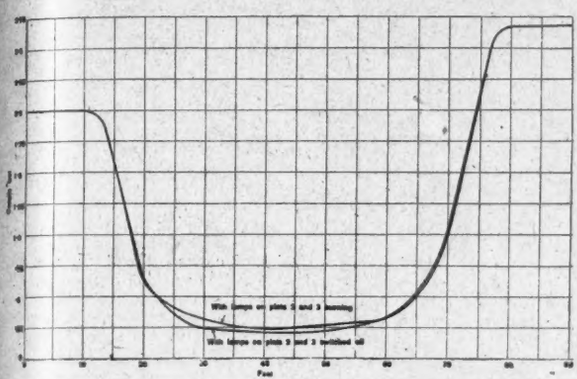


Diagram I.—Paddington Flame Arc Lighting.

flowing through each; the lamps were spaced 90 ft. apart, and were 18 ft. 9 in. from the centre of each globe to the ground. The lower curve gives the illumination due to these two lamps only, on a railway platform. The upper curve shows the illumination from these two lamps, as well as from a pair of similar lamps 48 ft. 9 in. away on a neighbouring platform. At minimum illumination, about midway between the two lamps, something like 15 per cent. of the total horizontal illumination is due to the lamps on the neighbouring platform. If Mr. Harrison were to measure this as he moved his photometer between the two lamps he would exclude this illumination in a more or less complete fashion. He would further exclude all illumination from the source behind him, and would then make up his illumination curve by calculation, but still excluding my 15 per cent. from a neighbouring lamp. Of course, his result would represent something, and he may justly say that measurement on a horizontal plane only represents something else, neither of the two being the total illumination at any one point. Measurement on any plane except the horizontal, however, excludes

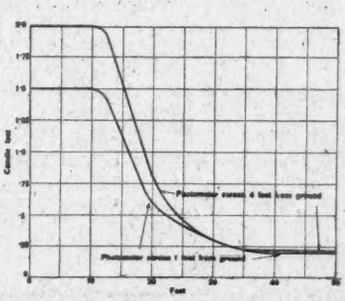


Diagram II.—Paddington Flame Arc Lighting.

illumination from other sources to a degree depending solely on the position of the photometer, and it is quite impossible that illumination curves measured by the two methods could be compared. It is to be noted in the curve above that one lamp is giving much more light than the other, but the consistency of the two curves at the maxima shows that the inequality was constant during the two tests, which covered a period of 20 minutes.

It is to be hoped that all who are really interested in the measurement of illumination will agree to adopt the principles laid down by Mr. Trotter, and measure all illumination on a horizontal plane. If for any reason candle-power is to be measured, it can then of course be measured by Mr. Harrison's method, but equally with his photometer or the Trotter type.

Another point in illumination measurements which should be agreed to by everybody is the height of the photometer screen from the ground. Curve No. 2 gives the resultant illumination from two Oliver arc lamps measured along a line vertically below them. The lamps were taking 9 amperes, and were placed 90 ft. apart, the centre of each globe being 18 ft. 9 in. from the ground. Only half the curve is given. The upper curve measures the illumination on a horizontal plane with the photometer screen 4 ft. from the ground. The lower curve shows the same measurement under exactly the same conditions with the photometer screen 1 ft. from the ground. For purposes of comparison what really interests the engineer is the minimum illumination, and it will be seen in the above case of what may be described as a high minimum illumination, namely, ·25 of a candle foot, that the difference between the minimum 4 ft. from the ground and the minimum 1 ft. from the ground is a very small quantity, probably not greater than the difference between results obtained by two observers. Anyone, however, who has had to take illumination measurements in a road, on a platform, or in a crowded position knows very well that the accuracy and quickness of measurement when the photometer is mounted 4 ft. from the ground is some three times as great as when the photometer is close to the ground. I therefore suggest that for the purposes of general illumination, 4 ft. from the ground be adopted as the standard height for all measurements of illumination on a horizontal plane. This height is admirably suited for the measurement of illumination in rooms, 4 ft. being approximately the level of the eyes of an average person sitting in an average chair.

Roger T. Smith.

Electrical Engineer's Department,
Great Western Railway, Paddington,
January 9th, 1908.

LEGAL.

A Bournemouth Tramway Assessment Appeal.

At the Poole Borough Quarter Sessions on January 6th, the Recorder delivered his judgment in the appeal (heard in London last summer) by the Bournemouth Corporation against a rate made on May 13th, 1907, by the Assessment Committee of the Poole Union, wherein the appellants were rated as occupiers of certain land, buildings, car-sheds, tramlines, and appurtenances, in the parish of Poole. The assessment published in the supplemental valuation list was reduced by the Assessment Committee, and the appeal was against the reduced figure, namely, gross estimated rental, £5,659; rateable value, £1,850.

The Recorder pointed out that he had to consider what rent might fairly be expected to be got in the conditions laid down by the Statute for the Poole undertaking. Where the evidence on both sides was so largely estimate and conjecture he thought he should be wrong to ignore the rent actually paid for this hereditament under a recent agreement. It was sufficient to say that an arrangement was come to in 1903, under which the Poole undertaking should be purchased by the Corporation of Poole, and then leased by them to the appellants, and the appellants should pay a rent equal to the interest and sinking fund on the sum raised by the Corporation of Poole to make the purchase. The purchase price, to be fixed by arbitration, was to be the fair market value of the undertaking as a going concern. This was fixed by the arbitrator at £100,000. The lower line was afterwards constructed at a cost exceeding £25,000, and the appellants were now paying, as rent for the hereditaments to be rated, interest at 4 per cent. on a sum exceeding £126,000, and were liable to pay sinking fund as well. This rent was admittedly large in excess of the rateable value. The appellants were in some difficulty owing to the judgment of the Court of Appeal. Moreover, the £100,000 included, or may have included, an unascertainable sum in respect of anticipated future profits. But in the arbitration in 1904 the Bournemouth borough engineer (Mr. Lacey) gave evidence on behalf of the purchasers and stated that the fair value of the undertaking was, in his opinion, £55,379. This included certain cars, for which the arbitrator seemed to have awarded £8,000, so that Mr. Lacey's real figure was about £47,000. He stated that he fixed this figure in view of certain onerous conditions in the statutory lease, and that he would have fixed a higher figure if those conditions had been absent. He allowed nothing for anticipated profit. He also stated that the appellants were at that time willing to pay interest and sinking fund on the sum received by him by way of rent for the undertaking and to do all repairs and maintenance. The Recorder could not think that the subsequent addition of the lower road, at a cost exceeding £25,000, could have reduced the rateable value of the undertaking, but he would assume that it did not add to such value. Leaving out the sinking fund and the cost of the lower road, 4 per cent. on £47,000 was more than the rateable value appealed from. He thought that he must include the appellants

among the possible tenants of this undertaking, and if it were to let to-morrow he had no doubt that the appellants would be among those ready to take it on terms. In considering what rent they could afford to pay, he thought they would have regard not only to the profits to be made in the parish of Poole, but also to the contributive value of this undertaking to the rest of their tramways, and to the advantage of maintaining their control over the entire system from Poole to Christchurch. He was satisfied that they would be willing to give now, for the whole undertaking, at least as much rent as they were willing to give in 1904 for the upper line only. For these reasons, after giving this matter the best consideration he could, he had come to the conclusion that this property might fairly be expected to let, in the conditions prescribed by the statute, for a rent which would justify the rating appealed from. He thought, therefore, that this appeal must fail.

Mr. E. R. Sykes, representing the Assessment Committee, applied for costs, to be taxed out of sessions, and the Recorder intimated that these would follow.

Zick *v.* London United Tramways Co., Ltd.

In the King's Bench Division on Monday, January 13th, Mr. Justice Jelf delivered considered judgment in the case of Zick *v.* the London United Tramways Co., Ltd., tried on December 9th last. It was an action brought by the plaintiff, a furniture dealer, of 84, Merton High Street, Wimbledon, to recover damages for trespass, thus depriving him of the use of his forecourt, and thereby interfering with his business. Defendants maintained that they were authorised by the London United Tramway Act, incorporated with the Lands Clauses Consolidation Act, to acquire the said forecourt for the widening of the roadway. On May 25th, 1905, they served notice upon the mortgagors who were in possession of the forecourt for the purchase of their interest; but on that date the plaintiff was not the occupier and had no interest in the premises. Notwithstanding the service of this notice, the mortgagors purported to grant an interest to the plaintiff by means of an agreement of tenancy. Plaintiff contended that the defendants were liable to him for damages for trespass, and that he was entitled under the Land Clauses Act to compensation for the compulsory taking of the forecourt as regarded his interest in the premises down to March 14th, 1908; and, on the other hand, the defendants submitted that, after the date of the service of the notice to treat for the purchase of the forecourt, the landlord could not create any fresh tenancy, and that the original tenancy had been surrendered by the operation of the law on the ground of the new tenancy. On the date of the alleged trespass, therefore, the plaintiff had no interest. He did not hold under the original tenancy and his new tenancy was invalid against the defendants.

His Lordship held that the plaintiff had a *prima facie* title and that the defendants had failed to displace it. He therefore gave judgment for the plaintiff for 40s. damages and costs, and declared that he was entitled to benefit under the Land Clauses Act for his interest for the period ending March 14th, 1908.

Sanderson *v.* Pearson.

In the City of London Court on Tuesday a claim was made by Mr. Frank Sanderson, member of the London Stock Exchange, 17, Bishopsgate Street Without, who sued Mr. George Pearson, 154, Abbott Road, Poplar, electrical engineer, for £20 money lent. Mr. Howard d'Egville appeared for the plaintiff, and Mr. L. Green for the defendant. The defence was that the money was advanced to the London Electrical Syndicate, Ltd., of which the defendant was the managing director. Plaintiff said that in 1902 defendant persuaded him to take up 120 £1 shares in the London Electrical Syndicate, Ltd., for which he paid in full. His partner, Mr. Levy, also took 160 shares. Later on defendant borrowed £20 from him privately. Defendant offered him 50 more shares for the £20, but that was declined by him. The cheque for the £20 was made out to the defendant, while the cheques for the shares were paid to the company. The company had since gone into liquidation, but the witness received no notice of it, although the defendant was the liquidator. Defendant recently told them he was running a company which was paying 75 per cent. dividends, and he, therefore, thought the defendant ought to pay the £20. The share certificates of the London Electrical Syndicate were not issued for two years. Defendant said the loan was to the company with which to pay wages, and it was quite as much in the interests of the plaintiff that the company should go on as in his (defendant's) favour. Plaintiff was sent notice of the liquidation. Witness had a fourth share in the company; but he paid nothing for his share originally, he admitted in cross-examination. Plaintiff agreed to take 20 shares for the £20 loan, and if they were not allotted to him it was an oversight. He found the inventor of the patents which were regarded as valuable. The company had since been reconstructed. Judge Rentoul, K.C., found for the plaintiff, but without costs.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Heating Apparatus.

At their new London show-rooms, which were recently mentioned in some detail in these pages, Messrs. Simplex Conduits, Ltd., have on view a number of very fine designs of electric heating apparatus of convector and luminous types. A couple of representative examples appear in the accompanying illustrations (figs. 1 and 2).

Fig. 1 shows a well-finished design of convector heater in a matt iron case with copper ornaments and a circular space in front fitted with glass, which, as the heater is illuminated by means of a ruby lamp, gives it a cheerful appearance when in use. The capacity is 1,000 watts, and it is regarded as a very inexpensive though tasteful fitting for a small dining-room, bedroom or office.

Figs. 1 and 2.—Examples of Simplex Radiators.

The luminous type of radiator (see fig. 2) is a very solidly-made but low-priced fitting of polished brass, riveted together throughout, carrying two of the usual radiator lamps, controlled by one switch. The highly-polished finish and reflector considerably add to the appearance of the radiator when lighted.

Large Morse Chain Drives.

The Westinghouse Brake Co., of 82, York Road, King's Cross, London, inform us that they have recently executed an order for what is probably the biggest chain power transmission yet attempted—that is to say, three Morse silent, high-speed, rocker-

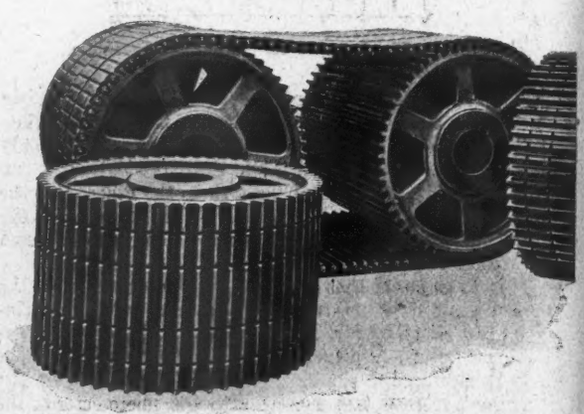


Fig. 3.—Large Morse Chain Gear.

joint drives complete, each to transmit 500 H.P. These drives were ordered by an engine works in Russia, Government of Moscow, which already had a 280-H P. Morse drive in satisfactory operation.

The accompanying illustration gives a good idea of the appearance of these large drives, of which the following are further particulars:—Diameter of wheels, 37·78 in.; face width, 22 in.; chain, 2 in. pitch, 10 in. wide; two chains running side by side over one set of wheels; chain speed, 1,480 ft. per min.

BUSINESS NOTES.

Electrical Trade with New Zealand.—The preferential treatment granted by New Zealand in November, 1903, to certain classes of imports from British dominions included rails for railways and tramways, and it is reported that the effect of the arrangement has been to divert to the United Kingdom and British possessions a portion of the trade formerly held by foreign countries in commodities affected by the preference. A statement to this effect appears in the Blue Book which has just been issued under the auspices of the Board of Trade on trade with New Zealand, and it is added that, in view of the revision of the tariff which was proposed last July and has since been adopted, a further favourable development is expected from the additional preference thereby accorded, particularly in respect of metal manufactures, electrical machinery and numerous miscellaneous articles. It appears that gas and oil engines are imported into New Zealand largely from the United States, but in the past two years the British share of the trade has advanced in value by over 50 per cent., whilst the business with the United States was less in both these years than in 1903. In electrical machinery considerable foreign competition comes into play, chiefly from the United States and the European Continent, but the United Kingdom is still credited with more than half of the total imports, some of its share, however, being undoubtedly also of Continental origin. The imports of electrical machinery may be summarised as follows:—

From—	1890.	1900.	1905.	1906.
United Kingdom ...	£8,706	£37,942	£91,338	£109,214
British possessions ...	213	6,305	20,110	30,145
United States	330	2,797	41,325	21,369
Germany	31	1,455	3,339	6,908
Belgium	50	21	3,539	17,446
Other foreign countries	—	—	143	2,615
Totals	£9,330	£48,520	£159,794	£187,697

The growth in the value of the imports from the United Kingdom is satisfactory, although the year 1904 was a record period with £118,000. The increase in the trade with British possessions is remarkable, the Colony of New South Wales alone being responsible for 75 per cent. of the total under this heading. But still more remarkable is the expansion in the business with Germany and Belgium, the former having doubled, and the latter having more than quadrupled, the value in 1906 as compared with the preceding year. This fact, too, has to be borne in mind in conjunction with the statement that some of the share attributed to the United Kingdom represents machinery from the Continent of Europe. In addition to electrical machinery, New Zealand imported from the United Kingdom telegraph and telephone cables and apparatus to the value of £31,611 in 1906, as compared with £8,554 in 1905, and unenumerated electrical goods and apparatus to the sum of £32,551 and £43,451 in the two years respectively; but no details are given in respect of similar imports, if any, from other countries. The imports of railway materials (presumably also materials for tramways) may be briefly set forth as under:—

	1904.	1905.	1906.
United Kingdom ...	£161,279	£172,732	£324,954
British possessions ...	4,917	2,256	5,114
Foreign countries ...	17,802	25,042	6,738
Totals	£183,998	£200,030	£336,806

The preponderance of the United Kingdom will be obvious, whilst at the same time the imports from foreign countries, mainly the United States, were less than in any year in the present century, if not less than in any previous year on record. The United Kingdom dominates the trade in portable and traction engines, and also holds about 60 per cent. of that in gas and oil engines, but only about half of the business in india-rubber and manufactures is credited to this country. The improvement in the value of the exports from the United Kingdom is attributed in part to the greater energy displayed by British manufacturers in recent years and partly to the operation of the preferential tariff. It is considered that, with the exercise of reasonable vigilance and attention to the desires, and perhaps the prejudices of consumers, there is no reason why British traders should not maintain and enhance their position in the market of New Zealand.

British Electrical Trade with France.—The Marseilles Exhibition.—Several references have recently been made in these pages to the Electrical Exhibition which is to take place at Marseilles this year. We have now received from the office of the London representative of this Exhibition (Mons. L. Jauffret, 77, Fleet Street, E.C.) a circular whose contents should be of considerable interest to firms who desire to promote better electrical trade relations with France, but who feel disinclined to devote much attention to the potentialities of that market because of their impression concerning the effects of Customs' duties. We understand that most electrical firms in London and some important provincial centres have received copies of this circular direct from the Commissioners; but as the contents are deserving of close study by others as well, we make fairly full reference to the points brought out. It is stated that the "most favoured nation" tariff has been applied by the French Customs to goods of British manufacture in virtue of the law of February 27th, 1882. The law of December 29th, 1891, authorised the French Government to continue the treatment to Great Britain by granting to British products the benefit of the minimum tariff from February 1st, 1892, and this was confirmed by decree of January 30th, 1892. British goods, therefore, enjoy the same privileges as goods of German and Swiss manufacture, whereas American products, for example, pay duty at the higher rate provided for by the "Tarif General." From the figures given below, which are extracted from the general trade returns for 1906, will be seen the weight and value of the imports into France of electrical plant, for local use, for two categories of electrical apparatus taken at random:—

No. of French tariff.	Description of goods.	Country.	Net weight kilos.	Value.
524	Dynamos	Great Britain... ...	462,000	£4,600
		Germany	4,120,000	41,200
		Switzerland	10,131,000	101,320
		United States ...	2,508,000	2?,080
		Other foreign countries	1,131,000	11,320
			18,352,000	£183,520
536	Dynamo armatures and parts for electrical apparatus	Great Britain ...	474.000	£8,520
		Germany	5,127,000	92,280
		Switzerland	1,299,000	23,400
		United States ...	814,000	14,640
		Other foreign countries	537,000	9,680
			8,251,000	£148,520

From these figures it appears that the imports into France of British electrical machinery and plant are not only much less than those of Germany and Switzerland, whose products are subjected to the same rate of duty (tarif minimum), but are also far from reaching the importance of this class of goods imported from America, which pay duty at the rate of the "tarif general," the latter exceeding by from 10 to 100 per cent. the rate provided for in the "tarif minimum." The General Commissioners, therefore, say that the British electrical industry cannot plead as a reason for the small position occupied in the French markets, that goods of British manufacture are less well treated as regards Customs tariff than those of Germany and Switzerland; moreover, it has a decided advantage over the latter in being able to ship at cheap rates from Liverpool and London direct to Marseilles. Full particulars concerning charges for space, &c., at the Exhibition can be obtained on application to Mons. Jauffret as above, but we may add that names of intending exhibitors should be sent in by February 1st, and all information regarding the consignment and installation of exhibits has to be furnished before February 15th, while all exhibits must arrive at Marseilles on March 20th at the latest.

A Diamond-making Plant.—A man called Lemoine has got into trouble through an alleged process for making diamonds with the aid of an electric furnace. On the strength of this, he obtained £64,000 from a South African "magnate" in Paris, and is now in custody.

Electrical Plant for the Manica Copper Development Co.—In their report for the three years ended December 31st last the directors refer to the steady development of the company's property in Manicaland. It is pointed out that in view of the increasingly favourable results that are being obtained under the direction of the manager, Mr. W. M. Cairncross, the board feel justified in embarking upon the immediate erection of machinery both for the treatment of the ore already available and for the more expeditious development of the mine in depth, where a marked enrichment of the gold and copper values is expected. Orders are accordingly being placed for a complete equipment of electrically-operated mining machinery, including rock drills, and a mill and concentrating plant capable of dealing with 500 tons of auriferous copper ore per month, the motive power being transmitted to the mine from a hydro-electric generating station on the Zambesi River about two miles distant. The mill has already been purchased and is now on the property, and the necessary surface works, with the exception of the water race, have been practically completed. The cost of the machinery and of the further development work contemplated has been provided for by the issue in December last of £10,000 6 per cent. mortgage debenture bonds. The manager is now in London conferring with the board on a number of important matters and supervising the preparation of the new machinery.

Copper in 1907.—In their annual trade review, Messrs. Bolling & Lowe, of 2, Laurence Pountney Hill, London, E.C., make the following remarks concerning copper supplies and prices during last year:—

"The threatened scarcity of copper, which, as intimated in our last year's report was probable, entered upon an acute phase in the early months of the year, and prices advanced to record figures during the memory of dealers in the metal. The inevitable collapse of which the premonitory symptoms manifested themselves in the early summer months, arose directly from the autocratic policy of the Amalgamated Copper Co. Early in the year this, the largest producer of the metal, withdrew entirely from the market, announcing that it had already sold all the copper which it wished to market during the first six months of the year. The feeling engendered by this announcement drove prices up to over £110 per ton for cash standard metal, but the anxiety of all outside producers to benefit from the extraordinary policy adopted by the leading producers resulted in their being able to satisfy all demands themselves.

"By the time that the Amalgamated Co. were again willing to sell copper, buyers had contracted with other producers for months ahead. The output of the Amalgamated Co.'s properties was therefore accumulated to an alarming extent, and we are probably well within the mark in saying that by the end of October the largest producers found themselves saddled with a stock of refined copper of 100,000 tons. The dispersal of this large quantity necessarily brought about severe market disturbances, both in London and New York, but it may be well to emphasise the fact that the chief sufferers from the collapse were the American themselves, who, for the second time within a very few years, badly mismanaged the selling end of their business.

"At the present time the outlook is not particularly brilliant. True, the stocks formerly held in America have been, to a very large extent, realised in Europe, mainly for the purpose of procuring gold, but there are large invisible stocks of copper now in the hands of dealers and others on this side of the Atlantic, and these being in existence at a time when trade everywhere shows signs of severe retrogression, is by no means an encouraging factor.

"On the other hand, the chief American producers, in order, so far as possible, to adjust their position, have made drastic curtailments of output, particular in their Montana Mines, while the wholesale discharge of employés in such important copper camps as those of Mexico and Australia may have a stimulating effect upon prices when to-day's accumulation is substantially eaten into by the actual demands of consumers.

"In attempting to look ahead, it must not be forgotten, however, that somewhere in the neighbourhood of £65 per ton for refined copper is a very fair price over a long average of years, and it would perhaps be too much to expect any material appreciation in price until the situation has cleared somewhat."

Book Notices. — *Willing's Press Guide, 1908.* Jas. Willing, Jun., Ltd. 1s.—This is the thirty-fifth annual issue of this well-known directory to the newspapers, journals, magazines, &c., published in the United Kingdom, also some of Colonial, Continental and American origin. The usual arrangement is adopted—a convenient alphabetical section leading off, and being followed by a classified section according to the interests, professions, &c., treated of by the papers.

"Electric Wiring and Fitting for Plumbers and Gasfitters." By S. F. Walker. London: Scott, Greenwood & Son. 1908. Price 5s. net.

"Iron and Steel." By J. H. Stansbie. London: A. Constable and Co., Ltd. 1907. Price 6s. net.

"Technical Dictionary in Six Languages." Vol. 2. Electrical Engineering, including Telegraphy and Telephony. Edited by Chas. Kinzbrunner. London: A. Constable & Co., Ltd. 1908. Price 25s. net.

"Bulletin of the Massachusetts Institute of Technology." Catalogue. December, 1907. Boston: The Secretary, 491, Boylston Street.

Messrs. Harper & Bros. are adding to their series of electrical handbooks a volume entitled "Electric Arc Lamps," by Mr. J. Zeidler and Mr. J. Lustgarten.

Electrical Developments in Lancashire.—In the *Manchester Evening News* for January 8th there appeared an interesting and informing article by "T. H." on "Electrical Progress: Rapid Developments in Lancashire." We make the following extracts:—

"It is safe to assume that over a million of money has been expended during the past year in electrical developments of various kinds in Lancashire. Although the electrical confraternity and the electrical producing industries which have sprung into existence during the last decade have no cause for great rejoicing on the score of profits, they have laid the foundations of a great and important future, not alone for themselves, but for the well-being of the industries which have given Lancashire a world-wide repute and standing.

"It is true that the staple trades of the shire have not resorted to electric usage to the degree that optimistic electricians may have desired, and it is also true that those who have adopted electricity are chary of publishing results and opinions to their industrial *confrères*, but this very reticence may be construed favourably. The reversions from electricity to other forms of power may be counted upon the fingers, and these instances may be accounted for satisfactorily from the electrician's point of view.

"The whole county is becoming netted with electric cables, which are the great groundwork for future operations on less costly methods, and the foundation on which success during this and subsequent years will be built. The system will ease prices, familiarise hesitating power-users with the new motive force in their midst, and render safe such extensions as will be necessary in the future. There are, of course, many districts in which no general supply of electricity is available, but there are few districts altogether without their installations in some form. In many, if not most places, electricity is employed side by side with other forms of motive power, and a satisfactory feature of its adoption-in-aid is that where supplies have been in the first instance tentative they have become as general as economical necessities would permit. Several large firms we could name which began on these lines are now almost wholly driven by electricity, and in quite a diversity of ways.

"A few years ago it was hoped that Lancashire manufacturers would have been the first to avail themselves of the industrial *force majeure*, but that hope has been fulfilled to only a very limited extent. What has been done, however, in this direction has proved eminently satisfactory, even though the cost has been parallel with steam cost. The advantages lie in quite a catalogue of other directions. Collieries, engineering works, the building trades, bleachworks especially, and the many lesser but necessarily adjunctive trades have been 'got upon the mains' all over Lancashire.

"Twelve months ago the three Corporations of Rawtenstall, Bacup and Haslingden were in the throes of a controversy as to which authority should provide the electricity supply, or whether the Lancashire Electric Power Co. should deliver it through a central station at the central borough. Rawtenstall has since obtained large Parliamentary powers, and has determined to have its own generating station. Bacup has been compelled to follow suit, and Haslingden is uncertain whether it will obtain a supply from Accrington or also adopt the method of the other two boroughs, to which it has certain geographical and commercial ties. What will be the outcome of this extraordinary series of manœuvres it is impossible to forecast, but the position is one of grave import to the respective rate-paying communities. It will, if carried out as at present forecasted, assuredly form the strangest freak to be found in the electrical world. It is a feature of the year's movements that the asperities of the municipalities towards power companies have in great measure been softened down, and that some Corporations are seeking to co-operate with the power companies, not only in Lancashire, but in other parts of the country. . . . . Manchester possesses the largest municipal electrical plant in England, and one of the largest firms in the world engaged in the manufacture of electrical requirements, and it is fitting that the present year will see inaugurated in this city one of the largest electrical exhibitions ever held in the country. The whole trend of things points to this part of England becoming one of the most central electrical areas in the world."

Bankruptcy Proceedings.—George Kaye Spivey, electrical engineer, 34, Pinderfields Road, and lately trading at Market Place, Wakefield, Yorks. The receiving order in this case was made on the debtor's petition, and he attributes his failure to "loss through experimenting with inventions relating to motor-car improvements, and loss through auction sale of trade utensils, &c." It appears that the debtor started in business as an electrical engineer at Dewsbury, in 1899. His capital consisted of about £25 in tools and cash, and at that time he was clear of liabilities. About six years ago he was in partnership with Harry Birch, and they traded under the style of Spivey & Co. They traded together for three years, and the debtor was then appointed as electrical engineer for work for the Yorkshire Heavy Woollen District Tramways. As Mr. Birch would not join him in that enterprise the partnership was dissolved, the former being paid £325. Shortly afterwards the debtor was joined by another partner, who introduced £1,000 into the business. The debtor's capital was then £500. In October, 1905, he was paid out of the business, receiving £150 as his share. The large reduction in the capital is said to have been caused by a fire, by which the partners lost £1,200. On March 11th last, when giving up business at the Market Place, he executed a deed of assignment to a trustee on behalf of his creditors. At that time the unsecured liabilities were £256 12s. 9d., and the trustee has realised £35 19s. 4d., which, after paying preferential claims and wages, has been reduced to £6. The household furniture is claimed by the debtor's wife. He first became aware of his insolvency in January, 1907, since when he has not contracted any debts that are now owing. His statement of affairs shows gross liabilities amounting to £116 8s. 1d., all of which are expected to rank. The assets consist of cash in hand amounting to £10, and a deficiency is shown of £106 8s. 1d.

William Marshall, electric cable jointer, 49, Paget Road, Plumstead, Kent.—A receiving order was made on January 9th on debtor's petition.

Calendars and Catalogues.—Messrs. Alfred Herbert, Ltd., Coventry.—New edition of Section J of their catalogue (50 pages), fully describing and illustrating, in their usual manner, their hexagon turret lathe.

Messrs. Ludw. Loewe & Co., Ltd., Farringdon Road, London, E.C., have sent us one of their desk diaries for this year, each daily slip being perforated for tearing off as the day passes.

Dewhurst's Engineering Co., Ltd., of Sheffield, have sent us a couple of very acceptable wall calendars with monthly slips. Both are in colours, one being a reproduction of "Nathalie," by Alfred Schwartz, the other a marine view, "In the Midwatch," from a painting by Sheppard.

Messrs. Bradbury & Co., Ltd., Wellington Works, Oldham.—Leaflets illustrating and describing their 3½-in. and 6-in. centre capstan lathes, their improved 8-in. centre friction back-geared capstan lathe, and some specimens of work made therewith.

Messrs. Johnson & Phillips, Ltd., Charlton.—New catalogue, well illustrated (16 pages), giving particulars, sizes and prices of

their Paterson's vulcanised bitumen cable. The firm's bitumen department has recently been enlarged, making quicker delivery possible. The high-tension distributor cable for the L.B. and S.C. Railway is being sheathed with Paterson's vulcanised bitumen.

Messrs. John Spencer, Ltd., of Wednesbury, have sent us one of their circular pocket changing calendars for from 1907-1927, also a trade price list of their tubes and fittings.

Messrs. Davis & Timmins, Ltd., York Road, King's Cross, N.—Card showing prices per gross of standard Whitworth finished hexagon brass nuts (from ¼ in. to 1 in.) stocked by the firm.

The Electric Construction Co., Ltd., Dashwood House, London, E.C.—Very neatly-produced brochure giving a brief description and illustration of their new ball-bearing type of continuous-current motor.

Messrs. Vérity's, Ltd., Aston, Birmingham.—New publication (No. 570, 56 pp.), uniform with their Aston motor and arc lamp catalogues, giving abridged information concerning their switchgear and switchboards. Small illustrations, very brief descriptive notes, prices, shipping particulars, and dimensional drawings, are given of a variety of switches, fuses, switchboards and switchboard material. The greater part of the apparatus listed has appeared from time to time in other publications. Those now published for the first time are the following:—Open protected fuses for 1,000 and 2,500 amperes; street lighting switch; two useful voltmeter switches of the "Radial" and "Straight Line" type; two voltmeter plugs, viz., the "Cordless" type and the "Multiple Plug" type; ornamental switchboard pediments in wrought-iron.

Dissolutions and Liquidations.—City of Wellington Electric Light and Power Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. H. E. Salt, Winchester House, E.C., by January 24th.

Witting, Eborall & Co., Ltd.—A meeting is to be held at 49, Cannon Street, E.C., on February 15th, to hear an account of the winding-up from the liquidator (Mr. S. C. Witting).

Anchor Cable Company, Ltd.—According to a statement made on Saturday at the annual staff dinner of the Anchor Cable Company, Ltd., at Leigh, South Lancashire, this company, which is under the direction of Callender's Cable and Construction Company, Ltd., is so prosperous that its existing contracts will keep it working full time at high pressure until the end of this year, at any rate. Cables are being made for the British Admiralty, the War Office, and the Post Office, and orders have also been booked from Germany and Japan. The Anchor Co. have obtained contracts for the German Navy in competition with German firms.

Milan Exhibition.—The Armorduct Manufacturing Co., Ltd., write to draw attention to the fact that they have refused to accept the Awards given to them at the Milan Exhibition, although in our last announcement their name appears in the list.

Trade Announcements.—In order to devote their attention particularly to the manufacture of dynamos, motors, switchboards, arc lamps, and other specialities, the Westminster Engineering Co. have disposed of the wiring, fittings and installation branch of their business, carried on since 1890, at 16, Davies Street, Berkeley Square, W. Mr. Walter Rigg, who managed the branch for seven years, retains his position with the new proprietors, who will continue the business under the name of Girdlestone & Co., but neither the Westminster Engineering Co. nor Mr. J. O. Girdlestone, the managing director of the company, have any interest in, or are now in any way connected with, the business. The offices and sales department will remain at Victoria Road, Willesden Junction, but Messrs. Girdlestone & Co. will act as agents for the sale of the company's manufactures. We understand that the company are busy in all departments.

Mr. S. Thomas Pemberton, A.I.E.E., Council Chambers, 109, Colmore Row, Birmingham, who has been the Midland Counties representative for Electromotors, Ltd., Openshaw, for some time past, informs us that in future he will act as sole agent in this district for the following firms in addition to Electromotors, Ltd.:—Messrs. Dorman & Smith, Messrs. Connolly Bros., Ltd., and the Gilbert Arc Lamp Co.

Mr. J. Whitaker Taylor has opened an office at Lord's Chambers, 26, Corporation Street, Manchester, where he will carry on business as a mechanical and electrical engineer. He invites electrical firms to send him copies of their catalogues.

Mr. J. Sambidge, late of the British Westinghouse Co., and Mr. E. W. T. Ward, late of the Phœnix Dynamo Manufacturing Co., have commenced business under the title of Sambidge & Ward, at 17, Victoria Street, London, S.W., as mechanical and electrical engineers. The firm is representing a number of manufacturers, among them being Thomas Thrige, of Denmark, for electric motors and lift gear, the Triumph Stoker Co., Ltd., Messrs. Whitehead Bros., ironfounders, and others.

Mr. G. Braulik announces that, owing to the reduction in prices of metal and other raw material, he has decided to forego the 10 per cent. charged hitherto, with the exception of opal shades, casing and capping, and O quality carbons, on which, for the present, an increase of 10 per cent. on list prices, less discount, is charged.

LIGHTING and POWER NOTES.

Blackpool.—Some rather strong comments were made at the monthly meeting of the T.C. relative to the provision of refreshments at the public opening of the recent electrical extension at the borough electricity works. They arose when Councillor Laycock moved that the account for £39 3s. from the Palatine Hotel Company, appearing in the minutes of the Tramway and Electricity Committee, be referred back. It was pointed out that the Corporation had considered it would be more honourable for it them than for the contractors to provide the refreshments, and the amendment was defeated.

Bolton.—The British Westinghouse Electrical Manufacturing Co. has pointed out that a negative booster in use at the electricity works is an infringement of its patent rights. The matter has been referred to the chairman, vice-chairman, town clerk, and the electrical engineer.

Brechin.—Considerable dissatisfaction is being expressed by the T.C. with the street lighting. The North of Scotland Lighting Co. has suggested the advisability of increasing the power of the street lamps, and a Committee of Inquiry is going into the matter.

Canada.—The Lighting Committee of the Montreal Corporation has made a provisional contract for 10 years with Mr. E. A. Robert and his associates for street lighting at the rate of £11 per arc lamp per annum, with an additional charge of 10s. when the lamps are on iron standards, wooden poles being generally used. The contract applies to the whole city and necessitates new machinery at the Beauharnais Falls station. The contractors also undertake to supply energy to private consumers at the rate of 5d. per KW.-hour for incandescent lamps, with a discount of 10 per cent. on long-period contracts.

At the Toronto elections, held on January 1st, the majority in favour of the "power by-law" (an affirmation of the city's desire to take power in bulk from a Niagara company, rather than from the Toronto Lighting Co.), was 10,370 votes against 4,601. No candidate who opposed the by-law was elected.

Carmarthen.—The T.C. on January 10th decided to request Messrs. J. H. Saunders & Co., who are applying for a prov. order for E.L., to include certain streets in the main cable area, otherwise refusal of consent objections will be lodged.

Continental Notes.—Turkey.—The Turkish Ministry of Public Works has received an application for a concession for the establishment of electric light and electric traction at Monastir. The applicant is Mustafa Shukri Bey, the vice-president of the Chamber of Commerce.

Two Italians have also applied to the Smyrna authorities for a concession for the electric lighting of that town.

Italy.—A company has just been formed at Carrara with a capital of £24,000 and the title La Società Elettrica Apuana, to put down a plant to utilise certain available water-power in the generation of electrical energy for lighting and power purposes.

Douglas.—The T.C. has written to the Manx Electric Railway Co., asking them upon what terms and conditions they would be prepared to electrify the present tramway system and supply public lighting along the routes; also the price per unit at which they would be prepared to supply electrical energy to the Corporation mains.

Dublin.—It is stated that the Corporation intends to oppose the Bill that is being promoted by the Dublin and Central Ireland Electric Power Co.

Farnham.—The E.L. order of the Farnham Electric Light Co., which is due for revocation, is being extended *pro tem.*, pending an application to the U.D.C. for permission to adopt overhead transmission.

Gillingham (Kent).—The T.C. has decided to appoint, as an experiment, a canvasser for the purpose of increasing the E.L. business, at a salary of 30s. per week, and a commission of 3d. per light obtained.

Heywood.—At a meeting of the local Electricity Committee, held the other day after hearing a report from Mr. J. R. Salter, whom it had consulted on the matter, it decided to adjourn the question of extending the electricity works.

Hinckley.—The E.L. company has decided not to apply for E.L. powers for the district "owing to the uncertain attitude taken by the U.D.C."

Kingswood.—The B. of T. has informed the U.D.C. that it has decided to defer revoking the E.L. order granted to the Electric Supply Co. until May 1st next.

London.—Marylebone.—The Electricity Committee of the Borough Council has adopted the use of a wall-plug meter for the supply of electricity for radiators, power, &c., charging at power rates without a separate circuit. The meters will be rented at a charge of 2s. 6d. per quarter for the 100-unit size.

Hackney.—At the meeting of the B.C. on January 9th it was decided, in view of the high rate of interest charged by the L.C.C., to invite tenders for a loan of the whole or part of £34,265, repayable on the instalment or the annuity system. Of the total amount £31,815 is required for electricity purposes.

St. Pancras.—Mr. Sydney Baynes, electrical engineer to the B.C., has advised his Council to petition against the Bill to be presented by the Highgate Hill tramways, the London Electric Supply and London and District Electricity Supply Bills.

South London.—The proposal of the B. of T. to accept the audit of electric supply company's accounts by their own auditors is being opposed by the Lambeth and Camberwell B.C.'s; the latter points out that it is directly interested in the disposal of revenue accruing from its area, also in the supply in that area, under its purchase clause, and that these matters are not clear in the company's accounts.

Poplar.—The E.L. Committee of the B.C. has adopted the recommendation of its engineer to offer a rate of 2d. per unit for lighting (inside and outside), by agreement, for six hours' average lighting per day, or on similar conditions at 2½d. per unit for inside lighting only.

Islington.—The Lighting Committee has decided to apply to the L.C.C. for sanction to borrow £23,304 to provide an additional 1,500-kw. turbo-alternator, condensing plant, cooling tower, three water-tube boilers, feed pump, coal bunkers, &c.

Fulham.—The electrical engineer to the B.C. reports that the works extensions for which loans of £52,042 were obtained, are nearly completed, the cost actually amounting to £46,411. He advises certain additions to the workshop at the generating station, and the addition of extra cables in High Street, rendered necessary by the increasing demand for power and lighting.

Merthyr Tydfil.—The T.C. has decided to substitute electric lighting for gas on the main road from Swan Street to the New Road, Dowlais. The present cost is £364 10s. per annum, and the estimated cost of electricity, with double the number of lights, is £321.

Oldham.—At the last meeting of the T.C. attention was called by Councillor Isherwood to the Electricity Committee's inability to accept an offer by a firm to take energy for driving a newly-constructed spinning mill at Waterhead. If the mill could have been supplied with energy, others would come forward with similar applications. Alderman Bolton, speaking on behalf of the Electricity Committee, said the Corporation's installation was unequal to this demand, and compliance with the request would have necessitated a capital expenditure of £80,000. It was a big mistake, in the first instance, not to have put plant down that would meet prospective requirements. Only that day, Mr. Bolton added, the Committee had received an application for the supply of 1,000 h.p., and found that, even to comply with that request, the T.C. would have to expend £18,000 or £20,000 on new plant. If all the calls were to be satisfied a capital expenditure of something like £100,000 would be necessary. The Committee separated without any practical proposal being submitted.

South Africa.—Victoria Falls Power Co., Ltd.—In a recent interview with the general manager, Mr. A. W. K. Pierce, of the Victoria Falls Power Co., Ltd., mentioned in the *East Rand Express*, it was stated that work has been commenced on the Simmer Pan site for the generating station, which will be the largest station in South Africa. The station and quarters will cover a site of 17 acres, and the plant at present proposed will consist of six 3,000-kw. turbo-alternators, two of which sets it is hoped to have running by August next, and the balance by about the middle of 1909. The boiler house plant will consist of 24 B. & W. boilers of an evaporative capacity of 17,500 lb. each. It is estimated the outlay will amount to £600,000, which will include distribution lines also. The total plant to be eventually installed is 30,000 kw.

Stalybridge.—The Ray spinning mill just completed, will be supplied with power from the Joint Electricity and Tramway Board's station. Some 1,600 h.p. of motors are to be installed.

Wigan.—The B. of T. has informed the R.D.C. that the E.L. Order obtained in 1903 has been revoked.

TRAMWAY and RAILWAY NOTES.

Barnes.—Continued opposition is being shown to the proposed tramway scheme through Barnes and Mortlake. The ratepayers and prominent householders are urging the Surrey C.C. to oppose the Bill in Parliament.

Belfast.—At a public meeting held to consider the proposed purchase of the Cavehill and Whitewell tramway by the T.C., an amendment was carried "That the meeting declines to proceed with the Bill."

Bolton.—A crowded meeting of ratepayers has been held to consider the proposed construction of additional tramways in accordance with an agreement made with the late Sir W. W. B. Hulton. As an overwhelming majority of those present voted against the proposal, it is expected that the Bill promoted in Parliament in relation to that work, will now be dropped.

Brentford.—The U.D.C. has decided not to oppose the Bill promoted by the London United Tramway Co., which seeks powers to cross Kew Bridge.

Burnley.—On Tuesday evening, a town's meeting decided to extend the tramway system at an outlay of £70,000.

Chiswick.—The Council has decided to support Ealing's application for an injunction against the London United Tramways Co. on account of the noise occasioned by the cars, and will contribute £60 towards the cost.

Continental Notes.—Germany.—The Berlin Elevated and Underground Railway has just had a sharp experience of the effects of ice on the working of the high level sections, which consequently also affected the remainder of the railway. It appears that about 9 p.m. on January 6th a thick drizzling rain began to fall and speedily became converted into ice, owing to the severe coldness prevailing at the time. The ice attached itself to the wheels and rails of the elevated sections and isolated the coaches and stopped the motors. There were plenty of fireworks under the coaches. About 11 p.m. the interruption became so extensive that the working of the railway had to be entirely suspended. The trains on the line, by means of most strenuous endeavours, were brought to the nearest stations, where the passengers were compelled to alight. Shortly afterwards the stations were placarded with red posters bearing the words: "Temporarily stopped on account of ice." The ice also caused some irregularity in the working of the city (steam) railway in the late hours of the evening. An apparently official explanation of the stoppage of the electric railway states that "several hundreds of short circuits" occurred on the line, and it was, therefore, necessary to cease working completely in order to prevent damage to the generators at the power station. The clearing of the rails was quickly taken in hand, and this was assisted by rain, which fell after midnight to the extent of permitting the resumption of the service the next morning. The effects of the ice were also manifested on the Wannsee electric railway where, it is stated, the use of steam locomotives was frequently necessary to haul away the electric trains.

Three Mercédès electric cars of the type referred to in the last issue of the Electrical Review have been ordered for the use of the fire brigade of Hamburg.

Russia.—La Compagnie Belge pour les Tramways et Eclairage Electriques de la Ville de Saratov is making good progress with the establishment of the power station in that town. While arranged to receive seven 400-h.p. Diesel engines and dynamos, only five are to be at first put down. In addition to the lighting work, which at first will be equal to 35,000 lamps, the company has taken over 22 kilometres of horse tramway lines, which are to be electrified and extended to 45 kilometres. It is hoped to inaugurate the first of the electric tramways in June next.

The scheme for the conversion of the tramways in the city of Odessa into electric lines has at last been approved by the Russian Government.

Switzerland.—The municipal authorities of Berne propose to add an electric motor vehicle to the equipment of the local fire brigade.

Spain.—A tramway strike is in progress in Corunna, the service being maintained by means of the military. The cars are driven by artillerymen, who are accompanied by civil guards.

Crewkerne.—The U.D.C. has decided to support the application for power to construct a light railway from the town to Martock.

Croydon.—A deputation waited on the Council on Monday night, and urged that the tramways be extended to South Norwood *via* Addiscombe and Woodside. A petition signed by 3,000 residents was handed in, and the whole matter was referred to the Tramways Committee.

Darlaston.—The U.D.C. has referred to the General Purposes Committee the question of ½d. fares for children on the cars. It has been suggested that some of the local authorities within the area of the operations of the B.E.T. Co. be approached with a view to see if some joint representations cannot be made to the company to secure such fares.

Dundee.—The Tramway Committee has agreed to put compressed air brakes on six new cars being built at Birkenhead, the brakes to cost £65 for each car.

The Committee has decided to repudiate a claim for £15 expenses for several of the Brush Co.'s employés who visited Dundee in connection with the dispute as to the standard rate of wages.

Ealing.—At the last meeting of the U.D.C. it was proposed that a joint committee consider the feasibility and expediency of providing a system of electric tramways or motor-'buses from the southern and south-western part of the borough to the main roads. General agreement with the proposal as regards tramways was expressed, but objection was taken to the portion of the motion regarding motor-'buses. In the result the resolution was agreed to.

Glasgow.—Colonel Yorke, on behalf of the Board of Trade, conducted an inquiry on Tuesday into the circumstances attending the recent tramway accident in Glasgow, when two persons were killed and about a dozen injured. For the first time in Glasgow the inquiry was conducted in private. A report of the proceedings will appear next week.

Leith.—No agreement has yet been reached as to the proposed Granton extension, to which the Edinburgh T.C.'s consent is necessary. It is suggested that similar terms to those arranged between the two Corporations in regard to the working of the Pilrig Street line by Leith, shall be adopted in this case.

Leeds.—On Tuesday a town's meeting resolved to proceed in Parliament with a Bill for the extension of the tramways in Horsforth, Rawdon and Guiseley at a cost of £90,000, and to acquire the Pudsey tramways at a cost of £15,000, the District Councils of Rawdon, Yeadon and Guiseley having agreed to pay £400 a year for 11 years to the cost.

Liverpool.—The Electric Tramways Committee reports that last year's traffic beat all records. The receipts for passengers carried and earnings per car-mile were the greatest recorded. The passengers were 124,000,000; nearly two million more than in the previous 12 months. The receipts were nearly £572,000, or an increase of £8,000. The car-mileage was 12,200,000, representing an increase of nearly 116,000.

London.—The District Railway is now running 31 trains an hour during the rush hours of the day, which is claimed as a record. The express or non-stopping service inaugurated some weeks ago now includes 18 fast inward-bound morning trains, and 11 outward-bound evening trains.

WEST HAMPSTEAD COLLISION.—The signalman, W. J. Hollis, concerned in the recent fatal collision on the Metropolitan Railway, was tried on a charge of manslaughter at the Old Bailey on January 10th, and found not guilty.

PADDINGTON.—The B. of T. has approved the service by the L.C.C. of notice of purchase of the portion in London of the Metropolitan Electric Tramways undertaking in Harrow Road, and has intimated that at the proper time the Board will give every consideration to the question of the arrangements which may be considered desirable to meet the convenience of the public using the tramways, either by the L.C.C. working the lines itself and arranging for mutual running powers with the outside tramway authority, or by leasing the lines to such authority.

Morecambe — Heysham. — The electrification of the Lancaster, Heysham and Morecambe section of the Midland Railway is rapidly proceeding, and the 3½ miles length between Heysham and Torrisholme Junction is now finished. The first trial of the new rolling stock will take place over the electrified portion of the line on Sunday. The section which is being electrified is 9 miles of double track, four between Lancaster and Morecambe and five between Morecambe and Heysham. This will be the first single-phase railway to operate in Great Britain. The work is carried out by Mr. Rich. Deeley, loco. superintendent, whose electrical assistant, Mr. J. Dalziel, is responsible for the general scheme and details of the electrical equipment.

South Shields.—Considerable discussion has taken place as to the condition of the Corporation's new tramway rolling stock, which, it was alleged, was unsafe. As the result of an inquiry, however, it has been decided that the condition of the cars is not such as to necessitate expert opinion, as had been proposed. The Corporation has agreed to grant running powers to the Jarrow and District Electric Traction Co. over its lines.

Torquay.—The T.C. has agreed to the extension of the Dolter system of tramways on Torbay Road, on condition that the work is completed in three months.

U.S.A.—NEW YORK.—The public opening of the new tube railway under the East River, connecting the boroughs of Manhattan and Brooklyn, took place on January 9th. The new line, which will relieve the traffic on Brooklyn Bridge, is estimated to have a carrying capacity of 20,000 passengers hourly.

Walsall.—The Tramways Committee reports that the total cost of the reconstruction of a portion of the tramways in the borough, comprising about eight miles of single track, and including the electrical re-equipment of the lines leased to the tramway company and a contribution of £1,555 towards the cost of various road improvements, was £31,422, or £6,722 less than the estimated expenditure. The average cost per mile of single track was £3,928, or £1,540 less than was paid for the construction of new lines some years ago. It has been decided to repay £6,678—an amount borrowed in excess of the sum actually required for the work. The Streets Committee reports that the road improvements necessitated by the tramways reconstruction have been carried out at a total outlay of £3,110, which is £1,569 less than the estimate.

TELEGRAPH and TELEPHONE NOTES

Hungary.—At the end of 1905 the telegraph system comprised 23,718 km. of line, and 128,315 km. of wire; 82,785 of the latter were the property of the State, and 45,245 belonged to railways, while 274 were owned by private undertakings. The system represents an increase over 1904 of 282 km. of line, and 4,181 of wire. Two new circuits were opened, one between Budapest and Berlin, and the other between Budapest and Bukarest. The number of offices increased by 106 from 3,707 in 1904, to 3,813 in 1905, there being one office for every 5,049 inhabitants; 1,871 were owned by the State, 1,918 by railways, and 24 by private undertakings. Inland traffic showed an increase of 220,184 telegrams over the previous year, the total number being 5,927,643, as against 5,707,459. International traffic claimed 3,073,369 telegrams, of which 1,602,171 were despatched, and 1,471,198 received. There were also 532,850 telegrams in transit, making a grand total of 9,533,862 telegrams, or an increase over the previous year of 418,642 telegrams. Increases occurred in all classes of traffic above-mentioned. The number of words transmitted was 116,989,410, as against 108,714,704 in 1904, this being an increase of 8,274,706 words. The greatest number of telegrams was exchanged with Austria, viz., 2,183,989. Then follow Germany with 343,174; Bosnia and Herzegovina with 140,343; Roumania, with 84,010; Servia, with 75,922; France, with 61,891; Italy, with 50,770; and Great Britain with 33,203.

The telephone system owned 21,768 km. of line and 190,952 km. of wire, these figures representing increases of 2,217 and 22,023 respectively; 32,091 offices were open to the public, of which 3,223 were opened during the year. Considerable progress was therefore made in this system. The increase in the number of conversations was also very satisfactory, there being 83,024,244, or an increase over the previous year of 20,162,707, and an average of 4·3 conversations per inhabitant. The greatest numbers of international conversations were exchanged with Austria, Germany, Bosnia, Servia and Roumania, the figures being altogether 262,726.

The accounts do not show separate figures for posts, telegraphs or telephones, but receipts from telephones were 1,388,833 fr. (£55,583) on account of conversations, and 4,118,716 fr. (£164,749) from subscribers. The cost of maintaining the telegraph and telephone lines was 1,878,909 fr. (£75,159).

Manitoba.—On December 31st the Bell Telephone Co. of Canada agreed with the Dominion Government to sell its lines in the province of Manitoba to the Government. It is expected that the lines will be leased to an operating company under strict control. The American Bell Telephone Co., which owns 51 per cent. of the stock of the Canadian company, has ratified the arrangement.

Telegraphic Interruptions and Repairs:—

CABLES.		INTERRUPTED.	REPAIRED.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	.. Jan. 12, 1908 ..	..
Lagos-Kotonon		.. Dec. 4, 1907 ..	..
Tarifa-Tangier		.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		.. Mar. 9, 1904 ..	..
Brest-Dakar		.. July 22, 1907 ..	..
Scotland-Orkney and Shetland Islands ..		.. Jan. 2, 1908 ..	..
Bathurst-Bissao		.. Dec. 25, 1907 ..	..
Trinidad-Demerara		.. Jan. 8. 1908 ..	..
San Domingo-Curacao		.. Jan. 11, 1908 ..	January 13.
Paramariho-Cayenne		.. Jan. 11, 1908 ..	..
LANDLINES.			
Puerto-Barrios		.. Aug. 2, 1902 ..	..

Telephone Trials.—On December 17th a man named Samuel Wartski, who wished to use a telephone at a call-box, was refused connection because the operator did not hear him put the fee in the box. Thereupon, he threatened to break open the box, and actually did so—without, however, recovering his 2d. On Friday last he was fined 1s. and two guineas costs for the offence.

An inspector employed by the National Telephone Co. has been taken into custody on a charge of stealing a quantity of jewellery from a house at which he called to see the telephones.

Telephone Rates.—The Postmaster-General has agreed to receive a deputation in regard to the telephone question on Tuesday, February 11th, at the House of Commons. The deputation will include delegates from about 70 Chambers of Commerce, some 30 Town and County Councils and several large trading establishments. According to the *Times*, the following points will be put forward:—First, no objection is raised to the principle of the measured rate, but there is a unanimous opinion that the charges are excessive; secondly, the deputation will probably advocate a continuance of the flat-rate system; thirdly, strong representations will be made as to the future administration of the telephone system, and a request will be made to the Postmaster-General to make a definite statement in Parliament at the earliest possible moment.

Wireless Telegraphy.—It was recently reported that the German Government circles were considering the question of establishing an Imperial monopoly of wireless telegraphy and submarine signals. The report is, however, now declared to be incorrect in so far as the former is concerned. The view entertained in official circles of the Imperial Post Office is that the Royal prerogative in regard to telegraphy is also determinative in respect of wireless telegraphy, and that the regulations for the former must also apply to the latter without further ceremony. As the International Wireless Telegraphy Agreement will come into operation on July 1st, it is expected that new regulations for the interior of Germany will then be prepared, and if any defects in the existing regulations are found in respect of their application to wireless telegraphy, the opportunity will be taken to make additions so as wholly to cover the situation.

Wireless communication has been established between Casa Blanca and Paris. On Monday last a message was received on the Eiffel Tower from the armoured cruiser *Kleber*, announcing the arrival of the vessel. The distance between the two places is about 1,340 miles.

Since October 1st, 1907, the Telefunken Co. has received orders for 24 ship stations from various countries, and 31 coast stations, while 12 portable military stations have been ordered by the Argentine and four by Japan, making a total of 71 stations for the last three months. Six of these stations are for a minimum distance of 300 miles, and two stations for 1,000 miles, most of the remainder having a transmission distance of 150-250 miles. The value of the stations ordered amounts to about £50,000, to which must be added the cost of buildings, masts and installation.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ACCRINGTON.—24 houses in Stevenson Street, for Howard & Bullough, Ltd.
Additions to Grange Ironworks, for Lupton Bros.

ARBROATH.—E.L. and power station in South Grimsby, for Geo. Balfour electrical engineer, London.

BARNSLEY.—New Working Men's Club in Doncaster Road, Stairfoot. P. A. Hinchcliffe, architect, 14, Regent Street, Barnsley.

BERWICK.—Proposed new Secondary School for Girls (£8,000).

BIRKENHEAD.—Covered Wholesale Market for the T.C. (£10,857).
Municipal dwellings for the T.C. (£7,859).
New tapestry factory in Norman Street. J. R. Mewton, architect, 59, Hamilton Square, Birkenhead.

BLACKBURN.—New buildings for the Y.M.C.A. (£7,000).

BLACKPOOL.—Houses and motor house in Manchester Road, for Wm. Cardwell.
28 houses in Claremont Road, for Robert Fielding.

BOLTON.—New Church (St. Barnabas) to be built in Chorley Old Road.
Houses in Bertrand Road. Joseph Farnworth, architect, Bolton.
Proposed monument in Churchgate. Bradshaw & Gass, architects, Bolton.

BRADFORD (YORKS.).—New Wesleyan Reform Chapel at Little Horton. Walker & Collinson, architects, Cheapside Chambers, Bradford, York.

BRADWELL (DERBYSHIRE).—Reopening Nunley Lead Mines at Bradwell, Derbyshire.

BROADSTAIRS.—New church at Reading Street (£8,500).
Villas. W. L. Dowton, City Bank Chambers, 44, Theobald's Road, W.C., architect.

BROMLEY (KENT).—Conversion of South Hill House into Masonic Hall and Club, for the Bromley and West Kent Masonic Hall Co., Ltd. A. W. M. Dickins, secretary, White Hart Chambers, High Street, Bromley, Kent.

BURNLEY.—Proposed extensions at Weavers' Institute.

BURY.—New children's holiday home at Birtle Edge. W. E. Gill, architect, Derby Chambers, Fleet Street, Bury.

CADDER (N.B.).—Extension of the Parish Church.

CHATHAM.—New offices, for G. B. Winch, solicitor, New Road Avenue.
Mission room at Walderslade, for Rev. R. Hall.
Business premises in High Street, for Messrs. Burrell.

CHESTER.—New Council Schools at Boughton for the T.C. (£9,300). Douglas and Minshull, architects, Abbey Square, Chester.
(ELLESMERE PORT).—New chemical works at Stanlow Town, for Chas. Heathcote & Sons, Manchester.

CHIPSTEAD (near REDHILL).—Bungalow residence, for A. E. Lloyd.

CLAYTON-LE-MOORS (LANCASHIRE).—Houses in Atlas Street, for D. & J. Welstenholme.

DEPTFORD.—Additions to Messrs. Carroll's works, Church Street. G. Simmonds & Son, 62, Erlanger Road, Deptford, builders.

DERBY.—New institute for St. James's Parish. Architect, Percy Currey' Derby.

DUNFERMLINE.—New church halls in St. Leonard's Parish. P. M'Gregor Chalmers, architect, Glasgow.

EASTBOURNE.—Additions to "St. Cyprian's," Summerdown Road, for Mr. L. C. V. Wilkes. F. G. Cooke, architect, 2, Hyde Gardens, Eastbourne.
Shops and houses in Church Street. C. Crisford, architect, Gildredge Road, Eastbourne; Wm. Llewellyn, builder, Eastbourne.

EDINBURGH.—Double villa corner of M'dmar Avenue and Midmar Drive for Wm. Gavine.

ELLAND (YORKS.).—Detached residence in Victoria Road, lit by electricity. Thos. Kershaw, architect, Lancs., and Yorks. Bank Chambers, Halifax.

FARNWORTH.—Public refuse destructor to be erected. Council Offices, Farnworth, Bolton.
Extensions to paper and printing works, for Higham Bros.

FELIXSTOWE.—New Spa building, &c., for the U.D.C. (£4,100).

GILLINGHAM (KENT).—House and shop corner of Chester and Rainham Roads, for Mr. Dobson. E. F. Cobb, architect, 20, High Street, Rochester.
E.L. to be installed at Byron Road, Barnsole Road, and Richmond Road Schools, for the Education Committee.

GREENOCK.—New church and hall in Dempster Street in connection with Mount Pleasant United Free Church.

HALIFAX.—New warehouse. Utley, Hebblethwaite & Utley, architects, 10, Waterhouse Street, Halifax.

HANLEY.—Conversion of old post office, Percy Street, into Liberal Club premises. R. T. Longden, architect, Market Place, Burslem.

HASLINGTON (CHESHIRE).—Alterations and extensions at C.E. School. Plans approved by Board of Education.

HEREFORD.—Motor Car Works, for Nayler & Co., Ltd.

HITCHIN.—Houses in Fishpond Road, for W. Jeeves.
E.L. installation, Town Hall stage, for U.D.C.

HEYWOOD.—Proposed extensions and improvements to mill, for the Heywood Spinning Co.
Proposed addition to mil' at Hooley Brow, for J. Hindle.
Proposed new school in Magdala Street for local education authority.
Proposed extensions to technical school in Pine Street. Lancs. County Council.

HORLEY (YORKS.).—New nurses' home. W. Cooper, architect, 4, Kirkgate Buildings, Huddersfield.

ISLEWORTH.—Home for workhouse nurses. Clerk to the Isleworth Guardians.

LEEDS (CALVERLEY).—Houses on Oaklands Estate, for Walter Pratt and Wm. Pratt & Sons.

LEIGH (SOUTH LANCASHIRE).—Proposed Trades Hall. Secretary, Trades Council, Leigh.

LEITH.—Additions to the works of the Victoria Rubber Co., Ltd., Leith Walk.

LEMINGTON, SCOTSWOOD (NORTHUMBERLAND).—Business premises for Blaydon Co-operative Society.

LINCOLN.—Houses in Westbourne Grove, for M. Otter & Co.

LITTLE HULTON (LANCS.).—Proposed new infant school. Rev. J. P. Wilson, M.A., Vicar of Peel, Little Hulton, Bolton.

LONDON (GLOUCESTER STREET, W.C.).—Buildings. Frank Bush, Ridgmount Street, Gower Street, W., builder.
(NEWMAN STREET, W.).—Shops, showrooms, &c. W. King & Son, 3, Vauxhall Bridge Road, Westminster, builders.
(COMPTON STREET, W.).—Shop, &c. Grace & Marsh, Tamworth Street, Croydon, builders.
(W.).—Police Station in Upper Rathbone Place. J. Dixon Butler, surveyor, New Scotland Yard, S.W.

LONDON (GREAT EASTERN STREET, E.C.).—Premises for London & Provincial Bank (£1,670). V. Vagnolini, 33, Stirling Road, Clapham Rise, Clapham S.W., architect; J. Parsons, 190, Waterloo Road, S.E., builder.
(E.).—Hall in Whitechapel Road (£2,100). G. Baines & Sons, 5 Clement's Inn, Strand, W.C.
(MARK LANE, E.).—Shops and offices in Byward Street. John Greenwood, Ltd., Arthur Street West, London Bridge.
(WALTHAMSTOW.)—Additional blocks to schools in Selwyn Avenue. M. H. Prosser, architect, Education Committee, High Street, Walthamstow.
(WEST HAM, E.).—Additions to engine house for Coates Bros., Canning Road, West Ham.
(CANNING TOWN, E.).—Machinery warehouse for Cohen & Son. W. Stuttle & Sons, 1, Mattock Street, E., builders.
(SILVERTOWN, E.).—Additions to premises of Co-operative Wholesale Society, 99, Leman Street, E.
(CLAPHAM JUNCTION, S.W.).—Rebuilding railway station for London, Brighton and South Coast Railway Co.
(CRICKLEWOOD, N.W.).—Workshop and stores. H. Neal, 101, Cricklewood Broadway, N.W., builder.
(SILVERTOWN, E.).—Addition to hydraulic power house for Tate and Sons, sugar refiners, Silvertown, E.
(WEST HAM, E.).—Herb beer brewery. H. Harrington, 65, Bishopsgate Street Without, E.C., architect.
(FULHAM).—Installation for power and light by Messrs. Hodgkins, dyers and cleaners, High Street, Fulham, S.W.
(STRATFORD).—Factory for Jas. Whitefield, trading as the Aerated Candy Co., Brydges Road, Stratford.
(SHEPHERD'S BUSH GREEN, W.)—Branch at corner of Woodstock Road for London, City and Midland Banking Co., Ltd., Threadneedle Street, E.C.
(HARLESDEN, N.W.).—Buildings in High Street for Foster & Cranfield, 6, Poultry, E.C., surveyors.
(DUDDING HILL, N.W.).—Forty houses. J. C. Hill, 55, Glenmore Road, Hampstead, N.W., builder.
(TOOTING, S.W.).—Building in Mitcham Road. Robertson & Barrie, 1, Renmuir Street, Tooting, builders.
(STREATHAM HILL).—Motor garage. Treacher & Son, 73, Moorgate Street, E.C., architects.
(STRATFORD, E.).—Stores for the Continuous Counter-Check Co., Ltd., 14 and 14a, Leytonstone Road, Stratford, E.
(POPLAR).—Mortuary and coroner's court. Harley Heckford, borough surveyor, High Street, Poplar.
(CANNING TOWN, E.).—Iron building for Marsh, Vick & Co., Bidder Street, Canning Town.
(TOOTING).—Eleven houses in Kenlor Road. Taylor & Kensett, Mitcham Road, Tooting Graveney, builders.
(TOOTING).—Two houses and shops in High Street. W. Wallis, 23, Ramsden Road, Balham, builder.
(STREATHAM).—Development of Guildersfield estate. Fasnacht and Beale, 17, Old Queen Street, S.W., architects.

LOWESTOFT.—New secondary schools. R. B. Nicholson, town clerk, Town Hall, Lowestoft.

LUTON.—Ten houses in Hitchin Road for Irons & Oakley.

MANCHESTER.—New premises in Norfolk Street for the Palatine Bank, Ltd.
New Infirmary. Arnold & Sons, builders, Clarence Road, Leeds.

NEATH.—Proposed new workhouse for the B.G. (£40,000).

NEWCASTLE.—New council school at Whickham.

NEWPORT PAGNELL.—Houses in Caldecote Street, for O. H. Bull.

NORTHALLERTON.—New railway station (£17,000).

NORWICH.—Important extensions at the Isolation Hospital, lighted by electricity for the T.C. (£4,030). A. E. Collins, city engineer.

NOTTINGHAM.—Bleaching and lace dressing works. F. Ball, architect, 23, King Street, Nottingham.

PAISLEY.—Additions to Blackland Mill for the Bradford Dyers' Association, 39, Well Street, Bradford.

PENISTONE (YORKS.)—New school for the West Riding Education Committee. J. Vickers-Edwards, county architect, County Hall, Wakefield.

POOLE.—Additions to factory for Godwin & Co., at Hamworthy.

REIGATE.—New factory for the Monotype Co. at Salford.

RHONDDA (PENYCRAIG).—Alterations and additions to premises for the Penycraig Industrial Co-operative Society. R. S. Griffiths, architect, Tonypandy.

ROCHESTER.—Houses in Church Street, St. Margaret's, for W. Edmonds.

SCARBOROUGH.—Important additions to the Pavilion Hotel for R. Laughton. F. A. Tugwell, architect, 102, Westborough, Scarborough.

SHEERNESS.—Bungalow residence at East End Lane, Minster, for Mr. Kettle.

SHIPLEY (YORKS.).—New factory. S. Robinson & Sons, architects, 15, Cheapside, Bradford.

SPALDING.—Alterations to the premises of the National Provincial Bank.

STAMFORD.—Crown Hotel, to be rebuilt for P. Phipps & Co., Northampton. J. Ward, architect.

STANMORE (MIDDLESEX).—Additions to the Creameries, Church Road.

STOCKPORT (CHEADLE HULME).—Additions to the Priory for Chas. Briggs.
Proposed new police buildings. Borough Surveyor, Stockport.

SUTTON.—Residence. S. J. B. Stanton, 47, Cavendish Road, Brondesbury, N.W., architect.

SWANSEA.—Rebuilding of business premises in Oxford Street for H. Samuel, jeweller, Market Street, Manchester.
New Municipal Education Offices.
New schools in Oxford Street (accommodate 860) for the T.C. Mr. Laurence and H. W. Burrows, architects.
New parish hall, billiard room, &c., at Morriston, for Rev. David Williams, vicar.
Extensive additions to the ice factory of the Castle Steam Trawling Co., South Dock.

WALLINGFORD (BERKS.).—New church at Spencer's Wood, near Shinfield.

WALTON-ON-THE-HILL (SURREY).—Residence for J. Oliver, Leatherhead.

WARE.—Important extensions to the girls' grammar school (£4,250). Evans and Son, architects, Wheeler Gate, Nottingham.

WATFORD (MIDDLESEX).—Additions and alterations to school at Levesden. John Blackburn, architect, care of A. A. Millward, clerk to St. Pancras Guardians, Pancras Road, N.W.

WEST HARTLEPOOL.—Electrical sub-station for the North-Eastern Railway. Wm. Bell, architect to the company, York.

WESTON-SUPER-MARE.—New Masonic hall. Hans Price & W. Jane, and S. J. Wilde and Fry, joint architects, Weston-Super-Mare.

WHITBY.—Additions to residence at Ugthorp (£2,000) for Messrs. Robson, Warrington.

WORSLEY.—Proposed hospital for Worsley and Swinton District Councils.

WORSLEY (LANCS.).—Villa residences. W. Farnworth & Sons, Hazlehurst, (builders), Worsley.

YARDLEY.—New secondary school in Warwick Road and Reddings Lane, Tyseley. A. Harrison, architect, Colmore Row, Birmingham.

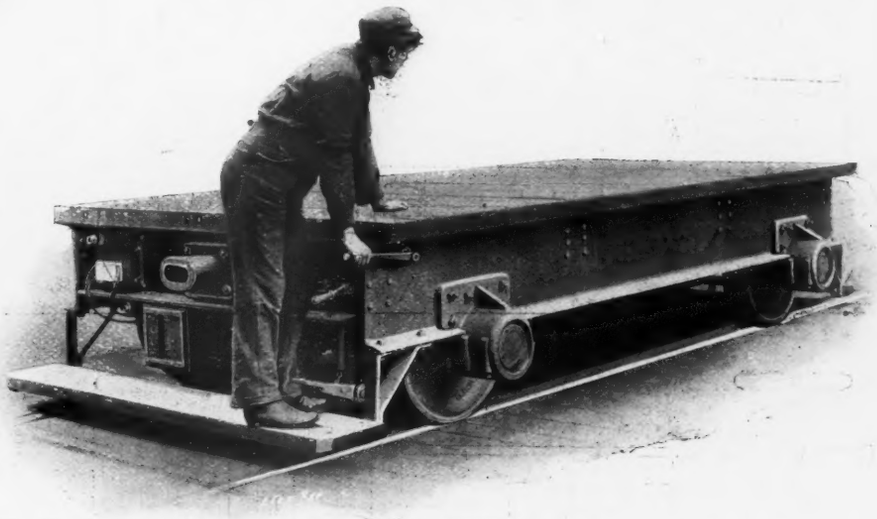
YORK.—Proposed public baths to cost £3,000.

STORAGE BATTERY AUTO-TRUCK FOR INDUSTRIAL RAILWAYS.

Beset by the problem common to all large industrial shops of economically transporting material from one part of them to another, the Westinghouse Machine Co. found the best solution in storage battery auto-trucks of its own design and construction.

These trucks have given such good results during several years of continuous service, and proved their fitness for the purpose, that the company has recently put them on the market in capacities of from 10 to 40 tons.

On account of the facility with which the trucks could be handled, delays of material in transit became practically unknown; and since the trucks furnished their own power, considerably fewer labourers were required for the moving of material. More important still was the marked improvement in crane service, as the cranes were no longer called for to transport castings below 10 tons in weight (the first trucks installed being of 10 tons' capacity). A lightly-loaded crane had often to travel from one end of the long shop to the other, driving several others before it and putting them temporarily out of action. When larger trucks were added a correspondingly greater improvement in crane service took place.



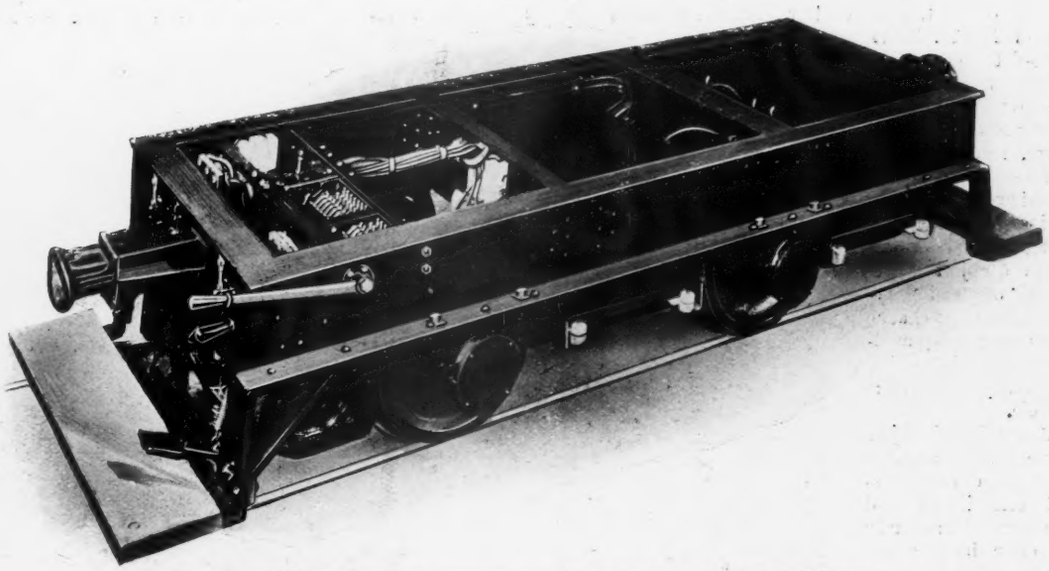
A Westinghouse Storage Battery Auto-truck.

The Westinghouse trucks, though of extremely simple construction, are substantially made. A steel frame, thoroughly braced, is carried on four wheels, the journals of which run in roller bearings. The driving axle or axles, as the case may be, carry the motor or motors, as in tramway practice. The motor is spring suspended from the frame at one end, and connected to the driving axle by suitable reduction gearing. A spring-suspended cradle of angle-iron carries the battery trays.

At the operating end of the truck are mounted the controller, brake, charging receptacle, cut-out switch and volt-ammeter; and a convenient step and draw-bar head are provided at each end.

All the electrical equipment is below the top of the frame and covered by a heavy wooden deck for carrying the load, the deck being removable so that any part of the mechanism is readily accessible.

During a six months' test of the standard 10-ton truck herewith illustrated, the power required to charge the battery in regular and heavy-shop service was accurately recorded, and averaged 63 KW.-hours per month. At the high figure of 2½d. per KW.-hour, the cost of this was only 13s.; while the work done averaged practically 700 ton-miles per month, the loads running from a few hundred pounds to 15 tons.



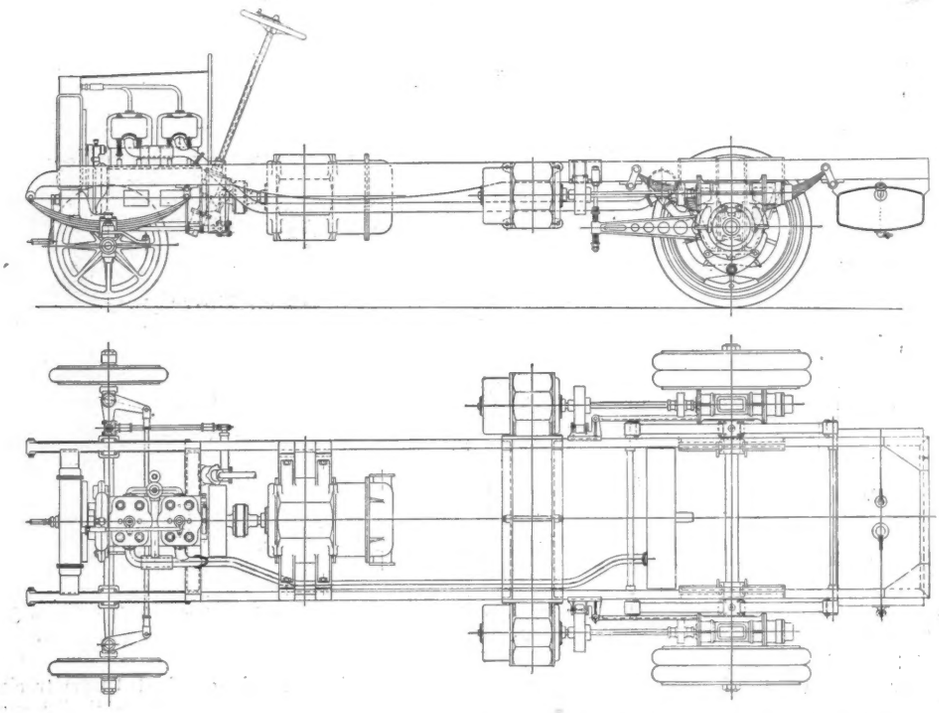
View, with the Deck Removed, showing the Construction of a Battery Truck.

Standard trucks are made for six different gauges, namely, 18, 21½, 24, 30 and 36 in., and 4 ft. 8½ in. Where tracks are installed with curves, the trucks for all gauges up to 36 in. are provided with swivelled front axles, to permit of free operation on curves as low as 12 ft. in radius.

F

THE HALLFORD PETROL-ELECTRIC OMNIBUS.

Through the courtesy of Messrs. J. and E. Hall, Ltd., of Dartford, we were, on Thursday last week, enabled to witness a practical demonstration of the capabilities of the "Hallford" petrol-electric omnibus built by them for Messrs. Tilling's London service and shown in fig. 3.



Figs. 1 and 2.—Plan and Elevation of the Hallford Petrol-Electrical Omnibus Chassis.

Starting from Coventry Street, W., a run was made through South London to Dartford, where luncheon and a tour of Messrs. Hall's up-to-date works filled in the interval until the return journey. As our readers are well aware, many types of petrol-electric equipment have been evolved during the past few years, all more or less with the object of getting rid of the disagreeable features of change speed gear and providing a smooth-running and easily controllable vehicle.

As a rule, this object has only been sought at the expense of considerable complication, and the general user may therefore be pardoned for doubting the practical value of arrangements which increased, even beyond the present possible, the number of chances of breakdown.

Complication of a kind is, of course, unavoidable in a mixed system such as that referred to, but we can safely say that the "Hallford" design is a straightforward one, in which the questionable mechanical features of the gear-box and differential have been superseded by a simple electrical system and worm transmission. It must be admitted that the 'bus showed its adaptability to average street traffic conditions, and demonstrated, as might be expected, the easy-running possibilities associated with electrical control.

The system of transmission adopted is a combination of the patents of the S.B. and S. Syndicate and W. A. Stevens, Ltd., and consists of a specially designed back axle, on which is mounted the final worm drive; the peculiar design of the axle being responsible for the unique arrangement and position of the electric motors and transmission shafts, &c.

Figs. 1 and 2 show the general arrangement of the chassis and equipment.

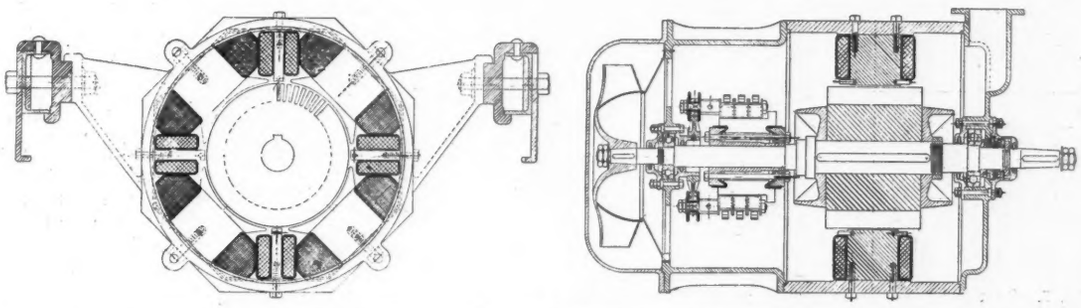
Starting from the front of the chassis, we find the standard "Hallford" radiator and bonnet enclosing a four-cylinder petrol engine of 30-h.p. R.A.C. rating.

Following the ordinary "Hallford" design, the engine is supported on two steel cross frames on three points only, with a view to perfect flexibility in the frame. Coupled direct to the engine by means of a specially designed universal joint is a shunt-wound interpolar dynamo, and immediately behind this, as shown in fig. 6, is placed the controller, which is operated mechanically from the inner of the two hand levers shown on the same view. From the controller energy is taken direct to two 12-h.p. motors

Fig. 3.—The Hallford Petrol-Electric Omnibus.

bracketed outside the side members of the frame. The motors are series wound, and by means of the controller can be worked either in series or parallel, although the latter connection provides sufficient power for all ordinary conditions of London traffic. The motors are coupled through telescopic universal joints to cardan shafts arranged parallel with the side frames and thence through universal joints of the ordinary star pattern to cast-iron worms which gear into phosphor-bronze worm wheels. The worm gear has a reduction ratio of 12 to 1 and was supplied by Messrs. Brown, of Huddersfield; it is stated to reach an efficiency of 87 to 90 per cent. The worm wheels are bolted to heavy steel housings, which are mounted entirely on ball bearings, a section through a housing being reproduced in fig. 7. This clearly shows the arrangement of the load and thrust ball bearings, by which the worm wheel is supported. From this point the power is transmitted to the road wheels through a dog clutch, which has for its object the easy removal of the wheels and the prevention of any side strain to which the worm wheel might be subjected.

The casing of the worm wheel is bolted direct to a flange forged on the back axle, and the latter is carried in horn blocks, the bearings of which are spherical and are therefore capable of movement in every direction.



FIGS. 4 AND 5.—SECTIONAL DRAWINGS SHOWING THE POLAR AND VENTILATION ARRANGEMENTS OF THE STEVENS GENERATOR.

In fig. 6 all the controlling gear is shown. On the top of the steering wheel are two levers; the left-hand one partially controls the gas throttle, and the right-hand one the field resistance of the generator. The hand throttle lever only partially opens the throttle, so that the engine can run at a minimum speed of about 350 to 400 R.P.M. The engine is automatically governed down to a speed of 1,050 R.P.M., which is the maximum at which it can be run under any circumstances.

On the right of the steering wheel is a foot pedal which controls a main switch enclosed in the controller case by which the generator circuit is interrupted. This pedal and a gas pedal controlling the engine speed

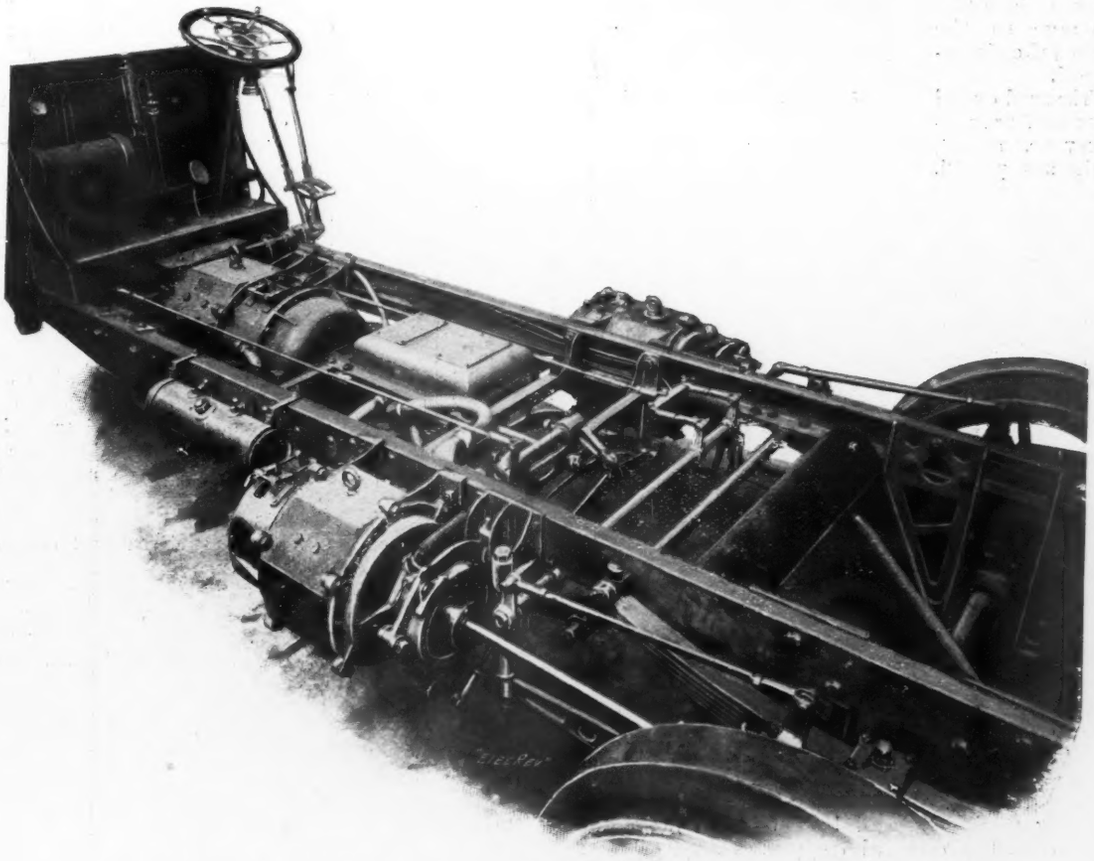


FIG. 6.—GENERAL VIEW OF THE CHASSIS, SHOWING ARRANGEMENT OF THE GENERATOR, CONTROLLER AND MOTORS.

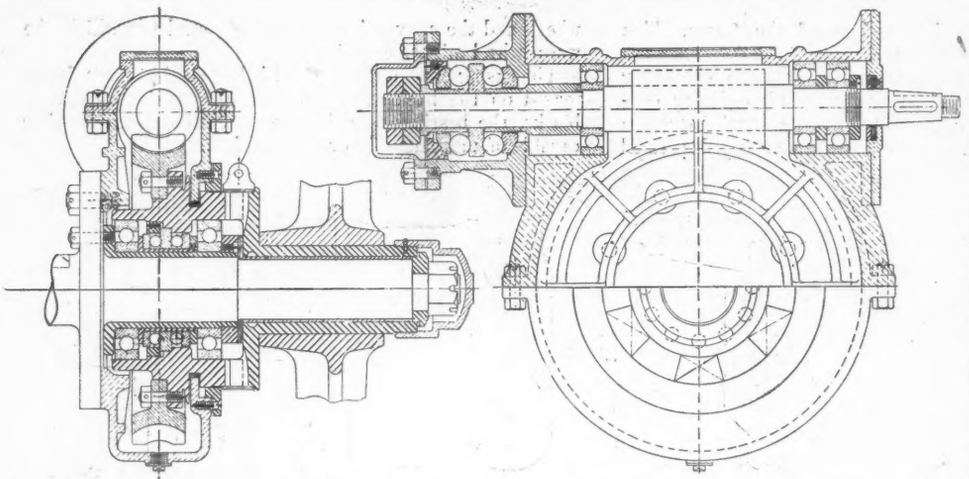


Fig. 7.—Sections showing Arrangement of Worm Drive to Main Road Wheels, Hallford Bus.

are both operated by the driver's right foot, and cannot, therefore, be depressed at once. It is thus impossible to break the main circuit while the engine is running fast, a precautionary measure by which damage to the main switch is prevented.

The hand control lever has four points —reverse, neutral, series and parallel. Each of these is exactly determined by hand locking gear on an ordinary quadrant. To prevent the controller being moved when the current is on, this handle is interlocked with the main switch pedal by means of a pawl and another quadrant with four notches corresponding to those engaged by the hand lever. As the switch pedal is depressed the pawl is lifted out of this quadrant, and the hand lever can then be moved and the arms of the control switch placed in any desired position. The notch in the interlocking quadrant corresponding with the neutral position is made shallower than the others, so that it is impossible for the main switch to be closed as long as the hand lever remains in the neutral position, thus preventing the starting of the omnibus with the handle in that position, owing to a possible short circuit in the system. The right-hand lever on the top of the steering gear, as already stated, operates the field resistance of the generator, which is utilised for starting the omnibus from the rest, and also on hills when it is desired to allow the engine to get away with the load. This resistance is placed under the bonnet.

With regard to the electrical equipment, the whole of which was manufactured by Messrs. W. A. Stevens, Ltd., of Victoria Works, Maidstone, perhaps the most striking feature is the sparkless running of the generator and motors. This is stated to have been tested to the extent of a direct short-circuit between the poles of the generator, which had no visible effect whatever on the commutator.

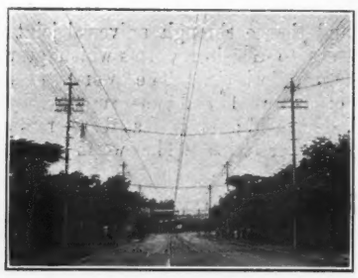
The generator is cooled by a fan mounted on the rear end of the armature spindle, figs. 4 & 5, which draws air in through a fine strainer on the front end of the generator, and ejects the warmed air through side passages.

The whole of the cables are contained in a flexible tube with screwed joints forming a waterproof casing, and one which is practically indestructible.

The great economy of the Hallford engine was abundantly demonstrated during the recent R.A.C. trials, and this is turned to good effect in the chassis now described. Owing to the high efficiency of the electrical transmission, it has been found possible to run from London to Hastings, an exceedingly trying road, with a load representing an omnibus body and half a dozen passengers on a petrol consumption of eight miles to the gallon.

In conclusion, we are much indebted to Messrs. Hall for their courtesy, not only in showing us the capabilities of their vehicle, but also for

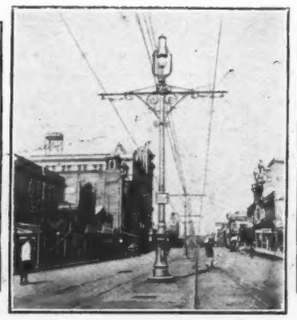
Low-pressure line, showing street lamps and house services.



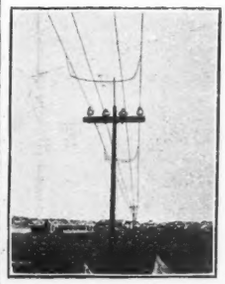
Side-pole construction, showing trolley, arc lighting, low pressure, and telephone wires.

Overhead Construction in Durban (see p. 103).

Fate of an inquisitive monkey on the L.P. line.

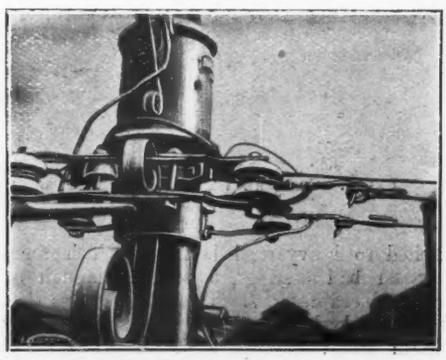


Centre-pole construction, showing trolley and arc lighting wires and guard wire.



High-pressure line, showing cross guard wires.

Overhead Construction in Durban.



Method of Attaching Arc Wires to Centre Poles, Durban.

enabling us to view the construction of their omnibus equipment in the shops.

Messrs. Hall are old-established makers of CO_2 refrigerating plant, and the construction of omnibus chassis, &c., is a recent addition rendered easy by an excellent equipment of machine tools.

It is of some interest to note that these works are electrically-driven throughout, some 120 motors and several welders being in use operated from the works power plant.

The group system of driving is adopted, a feature being the mounting of several adjacent motors with their control switchgear on a suspended gantry on the level of the shafting.

The works are electrically lighted, and also provided with electrically operated travellers.

The power plant includes two 220-KW. Willans-E.C.C. direct-current generators and several auxiliary motor-generators, controlled from a modern 32-panel switch gallery.

OVERHEAD MAINS IN SOUTH AFRICA.

[FROM OUR CORRESPONDENT IN DURBAN.]

WERE it not for the cheap means of distribution by bare overhead mains, it is certain that many of the towns in South Africa would not have faced the problem of a public electricity supply; for to-day we find some 30 odd supply authorities, and with the exception of only two places, bare overhead mains have been adopted for the L.T. supply, except in the business portions of some of the larger towns, where underground mains are in use.

The use of overhead mains has not been confined to L.T. work only, for in the Transvaal we have the Brackpan works supplying current at 12,000 volts over a length of 28 miles; the Germiston works supplying current at 3,300 volts for some of the mines; and there are also many other mining properties which supply current at various pressures. Later on we hope to hear of the Victoria Falls Co. supplying current to the Witwatersrand from the Zambesi, which is about 700 miles distant.

Now that the Board of Trade are sanctioning the use of overhead mains at home, it may be interesting to give an account of such work in South Africa, for which purpose we have taken Durban as an example, as it boasts of the most successful supply of any town there, financially as well as otherwise. The lengths of the various classes of line are as follows:—

H.T., 2,500 volts	·842	miles
L.T., 400 volts two- and three-wire ...	70·207	,,
Trolley, 550 volts (streets)	17·619	,,
Arc lighting, 550 volts (streets)... ...	7·946	,,
Motive power ,, ,, ...	1·571	,,
Total	98·185	,,

The area covered by the L.T. overhead mains supply is about 5 sq. miles, which area is divided into 19 districts, such districts being either fed from sub-stations or street transformers. The total number of consumers so supplied is about 2,400, and the success obtained is very conclusively proved by the reliability of the supply, the ease with which the most remote consumers can be reached at a minimum cost, and the immunity from accidents.

Our illustrations on p. 102 show very clearly the class of construction; in one of them may be noticed the first fatality that has occurred in Durban, the victim, however, being only one of the monkeys which run wild in the surrounding bush.

The distribution as at first installed was on the two-wire 200-volt system, but about one-half of the Berea district has been changed over to a three-wire system with 400 volts across the outers, and the remaining portion will in course of time be similarly dealt with. Underground armoured feeders are run from the sub-station or transformer box supplying a particular district, up the various poles, where they are forked, carefully taped and varnished, and sweated to the various mains.

The style of pole chiefly used is of a total length of 30 ft., and consists of a drawn steel tube, tapering from 5 to 2½ in. dia., and weighs about 245 lb. This tube is fixed by means of a split taper ring, into a cast-iron base 7 ft. long, weighing 245 lb., to which is fixed a sole plate 2 ft. sq., and at the top of the tube a lightning rod is fixed.

On some of the routes use has been made of the electric traction side poles, which were made specially long in order to carry telephone as well as electric light wires.

The poles are invariably fixed on the line of kerb, about 45 yards apart, and guyed where found necessary.

Wooden cross-arms are used, 3 ft. long by 3½ in. square, to support the shackles and insulators carrying the various mains, the terminal arms being strengthened by means of angle iron.

The mains for the principal streets are 19/17 size, for the side streets No. 6, and the switch wire controlling the 16-C.P. incandescent lamps for the public lighting is of No. 10 size.

In addition to the above, a guard wire is run about 1 ft. above the mains, which is ended off securely and connected by means of a clamp to each pole.

This wire also serves the purpose of minimising any disturbances due to lightning, which are further guarded against by lightning arresters of the "Wurtz" non-arcing metal type.

The arresters are fixed at all feed poles and prominent parts of the line, and the poles well "earthed"; the very few failures due to lightning has well proved the efficiency of these precautions. The service mains to the various houses are of No. 10 triple-braided weatherproof wire, and are pulled from the poles to the houses, through "flying" fuses, to meet the consumers' mains, and supported by shackles. The consumers' mains are of the twin-rubber and lead-covered class, split inside the roof close to the porcelain leading-out tubes. It has been found very desirable to use the lead-covered class of cable from the meter to the roof, so that it can be very easily distinguished from the ordinary house wiring, and no mistake can be made by unintentionally tapping the wrong main for any extensions which may take place. The iron roofs of the houses are securely connected to "earth" by means of a 19/16 cable, as a precaution against the roof being charged up.

Use has also been made of overhead mains for the arc lighting off the 500-volt supply, in which the centre tramway poles carry the cables as well as the lamps. In such cases shackles are used at each pole, supported by special iron clamps, and the mains of No. 6 size, instead of being bound round the shackle in the ordinary way, are fastened round a brass eye, which is held by a hook fastened to the shackle.

If by any means the wire breaks, both ends at once slip off the hooks, and the cable falls to the ground as a dead wire, thereby minimising any danger to the public. A guard wire of No. 6 size is used, fixed similarly to the L.T. supply; this wire serves the double purpose of protecting the trolley wire as well as the arc wires. Arc lighting wires are also used on some of the tram routes where there is span wire construction, and in this case such wires are supported, well clear of the poles, on the span wires by means of shackles fixed by special clamps.

Further use has been made of overhead mains for high tension purposes, the construction being somewhat on the same lines as the L.T. supply, with the exception of more efficient guards, insulators and shackles. Four wires of No. 6 size are used, the two outside wires being connected to the outer of the underground feeder, and supported by insulators, which are a little taller than the insulators carrying the two inside wires, which latter are connected to the inner of the cable.

By keeping the outer wires higher than the inside wires, they serve as a useful guard against any interference due to falling wires, &c. To guard against the inside or "live" wires falling, a cross-guard wire is looped under them and fastened to the two outside wires, a few feet out from each side of the pole, which puts on a "short" immediately either one of them falls, and the line is left "dead" by the station fuse blowing. Though somewhat more expensive on account of the greater number of insulators required for the four wires, the extra outlay is well warranted when the safety of the public has to be considered.

The costs of such construction and maintenance may be of special interest to many, and it must be remembered that the figures given here are on a much higher scale, both for material and wages, than would be the case in home towns, the wages being about double and material about 25 per cent. higher.

For a three-wire supply with 19/17 outers and No. 6 neutral the total cost of construction per mile works out at about £350, which figure includes a switch wire and incandescent 16-C.P. bracket lamp on every alternate pole; one man with four native labourers is able to erect about 70 yards of such pole line complete per day.

The cost of maintenance, taken over a period of three years, amounts to about £9 8s. per mile, or about 3 per cent. of the cost of construction; this does not, however, include renewals of poles, which, if well painted, should last for many years.

The average cost of house services comes to about £1 10s. without meter board and fuses, and an average service can be made in three hours, while, in some cases, a service can be made in half an hour at a cost of 5s. It has been found that two men with their native gangs can very efficiently maintain the whole of the 70 miles of L.T. route.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—ADELAIDE.—March 11th. The Postmaster-General requires tenders for the supply of one common-battery switchboard, 400 subscribers' telephones and 400 protectors.

MELBOURNE.—May 26th. The Postmaster-General invites tenders for a common-battery switchboard, together with all associated frames, racks, power plant and parts and apparatus for consumers. See this column for January 3rd.

Austria.—Tenders for the establishment of a central electric lighting plant at the new railway station at Bischofshofen are about to be invited by the Austrian State Railway authorities.

Belgium.—February 1st. The municipal authorities of Ghent are inviting tenders for the supply of 30 electric cranes, and the erection of the same along the new dock. Particulars may be obtained from, and tenders are to be sent to, L'Hotel de Ville, Ghent.

Belgium.—February 6th. The Belgian State Railways, telegraph branch, requires tenders for various telegraph construction material in 13 lots. A deposit of £2 8s. is required, and goods must be delivered within 18 weeks from acceptance of tender. Particulars may be obtained from the Direction des Voies et Travaux, 11, Rue de Louvain, Brussels, by referring to Avis Special No. 297/1907.

Belgium.—January 29th. La Société Nationale des Chemins de Fer Vicinaux, of 14, Rue de la Science, Brussels, is inviting tenders for the supply of 46 electrical sets, comprising two motors, for electrically-driven rail vehicles.

Bolton.—The Tramways Committee is in the market for six top-covers for tramcars.

Bristol.—February 17th. Electric lighting installations for various buildings, &c., at Royal Edward Dock, now constructing; also supply and maintenance of cables and appliances for conveying electrical energy to the various boards at the Old and New Docks, at Avonmouth, for the Docks Committee. For full particulars see "Official Notices" to-day.

Cardiff.—January 23rd. Extra-high-tension three-phase feeder cable, and one 500-KW. motor-generator for the Corporation. See "Official Notices" January 10th.

East Ham.—The engineer and manager of the tramways undertaking has been instructed to obtain quotations for top-covers for five cars, and submit them to the Committee.

Finchley.—January 20th. One 350-KW. high-speed engine and dynamo, &c., for the Council's electricity works. See "Official Notices" December 20th.

Germany.—February 6th. The Prussian Railways, telegraph branch, require tenders for 336,500 porcelain insulators; 77,000 metres telegraph cable; 25,000 kg. wire rope; 493,300 kg. zinced iron wire; 8,800 kg. insulated wire; 3,600 kg. copper wire, &c. Particulars may be obtained, for 1s. 6d. cash, from the Hansverwaltung, Dornhof No. 28, Cologne.

Germany.—January 29th. The Prussian Government Railways require tenders for a large amount of various telegraph construction material required for the districts of Hanover, Altona, Cassels, Erfurt and Muenster. Particulars from the Rechnungsbureau der K. Eisenbahn Direction, Thillenplatz No. 4, Hanover.

Germany.—The municipal authorities of Uelzen require tenders for an installation of public and private electric lighting. Particulars may be obtained from the Buergermeister.

Great Yarmouth.—February 1st. One 400-KW. D.C. traction steam dynamo for the Electricity Department. See "Official Notices" January 10th.

Holland.—February 1st. The Twent Electric Tramways Co. invite tenders for laying rails and crossings and accessory works on their Enschede-Gernerburg works. Particulars may be obtained from the Secretaire de la Société du Tramway Electrique de Twent, at Enschade.

Kilkenny.—January 18th. Suction gas plants, gas engines, electric generators, battery, switchboard, mains, wiring, &c., for the District Lunatic Asylum. See "Official Notices" December 20th.

London.—L.C.C.—February 4th. Five miles of low-tension lead-covered cable, and two miles of telephone cables, &c.; also laying of ducts, &c., and reconstruction for electric traction of the tramways in Caledonian and Seven Sisters Roads for the L.C.C. See "Official Notices" to-day.

Manchester.—January 20th. The Tramways Committee requires tenders for mackintoshes, leggings and sou'westers. Particulars from the General Manager, 55, Piccadilly.

N.E. Railway.—January 27th. The directors of the North-Eastern Railway are inviting tenders for the erection of an electrical sub-station at West Hartlepool.

Plymouth.—January 23rd. Stores for the Corporation Electricity Department. See "Official Notices" January 3rd.

Portugal.—March 11th. The Nova de Gaya municipalities require tenders for the construction, maintenance and working of electric tramways.

Pretoria.—At a Town Council meeting held on December 5th, it was recommended that tenders be called for a 500-KW. generator and 500-H.P. boiler and accessories, at an estimated cost of £12,000.

Rangoon.—March 31st. The Revenue Secretary of the Burma Government will receive tenders for the concession for 30 years, renewable for a further period of 20 years, for rubber plantations at Mergui (Tenasserim).

Russia.—SAMARA.—The T.C. is, according to an advertisement in the *Times*, inviting tenders from contractors for the construction and working of a central electric station, and also for taking charge of the organisation of the tramways at Samara. Particulars and conditions of the concession from l'Administration de la Ville de Samara.

Spain.—January 26th. The municipal authorities of Buñols (province of Valencia) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years. Particulars can be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Buñols (Valencia).

Spain.—Tenders have just been invited by the Spanish Post and Telegraph authorities in Madrid for the concession for the establishment and working of a telephone exchange in the town of La Garriga (province of Barcelona).

Spain.—The municipal authorities of Torrella de Montgri (province of Gerona) have just invited tenders for the concession for the electric lighting of the town.

Tunbridge Wells.—February 1st. High and low-tension cables for the Electricity Department. See "Official Notices" to-day.

Wimbledon.—February 18th. Flame arc lamp carbons for one year for the electricity department. See "Official Notices" to-day.

Wimbledon.—February 18th. One 1,000-KW. turbo-alternator, with condensing plant; two water-tube boilers, economisers, pipe-work and feed pump; switchboard and switchboard gallery, for the Corporation electricity department. See "Official Notices" January 10th.

Germany.—January 30th. Tenders are required for motors, conduits and all connections for electrically working the machinery in the railway workshop, Witten. Particulars may be obtained, at 1s. 6d. cash, from the Werkstaetten Inspection No. 3.

CLOSED.

Chatham.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of electric lamps, at £4 4s. per gross.

Gillingham (Kent).—The T.C. has accepted the tender of Mr. A. F. Smith, Gillingham, for the supply of Osram lamps.

Grimsby.—The T.C. has accepted the following tenders:

Johnson & Phillips, two years' cable supply, £1,358.
Phœnix Dynamo Co., engine and dynamo, £2,383.
Bertram Thomas, switchboard and wiring, £299.

India.—We understand that the India Office has instructed the electrical contractors for the Malakand hydro-electric scheme to place the order for the hydraulic turbines and governors, &c., with Messrs. James Gordon & Co., hydraulic engineers, of London, who are supplying three of their patent Samson balanced-gate turbines for direct coupling to A.C. generators.

London.—ST. PANCRAS.—The Board of Guardians has received the following tenders for the supply of electric lamps to the South Infirmary:—

J. C. Christie (accepted), 8s. 6d. per doz.
Charles Harrison, 9s. 8d. per doz.
Thomas Sampson, 10s. per doz.

The Kensington and Notting Hill Electric Lighting Companies' Joint Works, Shepherd's Bush, W., have placed a repeat order with Messrs. E. Bennis & Co., Ltd. It is for three Bennis-Miller-Bennett improved patent smokeless chain-grate stokers for a Babcock and Wilcox water-tube boiler.

L.C.C.—We understand that "Pivot" switches, made by Messrs. A. P. Lundberg & Sons, have been selected by the London County Council for their requirements during 1908.

STEPNEY.—The B.C. has received the following tenders for columns and brackets in connection with the lighting of Broad Street, Horseferry Branch Road, Medland Street and Wapping High Street, by arc lamps, and for the provision of columns or brackets for arc-lighting extensions up to December 31st, 1908:—

R. A. Bradshaw & Son, Retford (provisionally accepted) ..	£361 10 0
W. Lucy & Co., Oxford	392 5 0
W. Macfarlane & Co., Glasgow	533 10 6

Loughborough.—The T.C. has accepted the tender of Messrs Maulove, Alliott & Co., Ltd., for a refuse destructor, at £1,362, and that of Mr. J. T. Godfrey for a clinker railway, at £147.

Luton.—The T.C. has accepted the tender of the Chloride Electrical Storage Co., Ltd., for the renovation of the storage battery, at £559.

Manchester.—Messrs. Bruce Peebles & Co., Ltd., have received the Corporation's order for eight Peebles-La Cour motor-converters in sizes ranging from 250 to 600 KW., each machine receiving 6,600 volts, and converting to either 415/425 for lighting or 500/550 for traction.

Stalybridge (Lancs.).—Messrs. Bruce Peebles & Co., Ltd., have received from The Ray Mills Co., Ltd., an order for the complete electrical equipment of their spinning mill at Stalybridge.

Stockport.—The T.C. has accepted the following tenders:—

W. T. Glover & Co., cable, £14 18s.
Stockport Engineering Co., exhaust piping for 500-KW. set, £61.
Worthington Pump Co., atmospheric valve, £34 10s.
Lancashire Dynamo and Motor Co., 85-H.P. motor, £119; spare armature for 60-H.P. motor, £80.

ELECTRICAL ENGINEERS, R.E. (VOLS.).

The following orders are issued:—

Monday, January 20th.—"A" Company. Technical drill, 6 p.m.
Tuesday, January 21st.—"B" Company. Infantry drill (recruits), 6.30 p.m.; technical drill, 7 p.m.
Wednesday, January 22nd.—"A" Badge exam. for "C" and "D" Companies.
Thursday, January 23rd.—"C" Company. Infantry drill (recruits), 6 p.m.; technical drill, 7 p.m.
Friday, January 24th.—"D" Company. Infantry drill (recruits), 6 p.m.; technical drill, 7 p.m.
Saturday, January 25th.—Week-end run for Cambridge Det. at headquarters.

(Signed) J. H. S. PHILLIPS, Capt.,
Acting Adjutant.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 17th).—At 9 p.m. Royal Institution. Pro T. E. Thorpe, C.B., &c., on "The Centenary of Davy's Discovery the Metals of the Alkalis."

At 8 p.m. Storey's Gate, S.W. Institution of Mechanical Engineers Third Report to the Gas Engine Research Committee, by Prof. F. W Burstall.

Saturday, January 18th.—At 3 p.m. Royal Institution. Prof. Gisbert Kapp on "The Electrification of Railways." (Lecture I.)

At 10 a.m. Institution of Electrical Engineers. Students' visit to Messrs. Elliott Bros.' works.

At 7 p.m. Birmingham and District Electric Club. Presidential address by Mr. E. C. R. Marks.

At 7.30 p.m. Association of Engineers-in-Charge. Discussion, opened by Mr. A. E. Penn, on matters touched upon in the Presidential Address of Mr. W. H. Patchell.

Thursday, January 23rd.—At 7.15 p.m. Institution of Electrical Engineers (Leeds Section). Paper on "Notes on the Development of Turbo-Generators," by Dr. Pohl.

At 8 p.m. Institution of Electrical Engineers, London. "Standard Performances of Electrical Machinery," by Mr. Rudolph Goldschmidt.

Friday, January 24th.—At 7.30 p.m. At the Lit. and Phil., Newcastle-on-Tyne. North-East Coast Institution of Engineers and Shipbuilders. Paper on "Torsion Meters as Applied to the Measurement of the Horse-Power of Marine Steam Turbines," by Mr. J. H. Gibson.

Saturday, January 25th.—At 3 p.m. Royal Institution. Prof. Gisbert Kapp on "The Electrification of Railways." (Lecture II.)

NOTES.

Electrical Engineers' Ball.—This event, which has been held with increasing success during the last few years, is to be repeated at the Hotel Cecil on Friday, January 31st. Tickets can be obtained only from members of the committee, a list of whom appears below:—

Electrical Engineers' Ball Committee, 1908.

Alabaster, H.	Lane, W. E.
Baylor, A. K.	Leaf, H. M.
Bowden, J. Horace	Lloyd, G. C.
Bowden, H. W.	Madgen, W. L.
Burney, Guy	Matthews, W. Lee
Carlton, J.	Massey, W. H.
Callender, T. O.	Mordey, W. M.
Carolan, E. A.	McKay, H. T. S.
Clift, A.	McMahon, P. V.
De Segundo, E. C.	Nalder, F. H.
Erskine, R. S.	O'Meara, Major W. A.
Fell, A. L. C.	Partridge, G. W.
Flett, G.	Petersen, J.
Fox, E. J.	Raworth, J. S.
Gatehouse, T. E.	Rider, J. H.
Gavey, Sir J.	Roberts, Martin F.
Geipel, W.	Rutherford, W.
Glazebrook, Dr. R. T.	Rosenthal, J. H.
Gray, James	Siemens, Alex.
Gray, R. Kaye	Sillar, A. M.
Hadley, A. E.	Smith, F. A.
Hammond, Robert	Spagnoletti, J.
Harrison, H. E.	Stretche, T. E. P.
Hirst, H.	Sutton, G.
Highfield, J. S.	Sawtelle, E. M.
Kempe, H. R.	Sparks, C. P.
Kingsbury, J. E.	Taite, C. D.
Lacey, E. M.	Taylor, J.

Wallis-Jones, R. J.

Executive Committee.

Kingsbury, J. E.	Lloyd, G. C.
McMahon, P. V.	Roberts, Martin F.

Wallis-Jones, R. J.

Hon. Treasurer.

Hammond, R.

Hon. Secretaries.

Sillar, A. M. Alabaster, H.

The Social Welfare of German Electrical Workmen.—We recently referred to the question of workmen or shareholders' interests in German electrical undertakings, and it may now be of interest to show what the three principal manufacturing companies in that country have actually done for their employés in the past two financial years. The figures, which are abstracted from the annual reports, will probably give rise to some reflections in this country, not only on the part of British electrical firms, but

also among the ranks of their staff and workmen, even if the shareholders do not look at the amounts in question and imagine that the latter represent the divisible profits which they would like to receive, as the net trading results of the works for which they have provided the capital for establishment and manufacturing purposes. The importance of the money involved is so considerable, that it seems desirable to place the figures out prominently in the following manner:—

	1906-7.		1905-6.	
	Pension and benevolent funds.	Bonuses and profit sharing.	Pension and benevolent funds.	Bonuses and profit sharing.
Allgemeine Electricity Co.	£30,000	£25,000	£25,000	£25,000
Siemens & Halske Co. ...	17,500	30,000	15,000	25,000
Siemens-Schuckert Works Co.	17,500	40,000	15,000	30,000

The table indicates that the three companies have appropriated a total sum of £160,000 out of the net profits in 1906-7 for the benefit of officials and workmen, this comparing with a total of £135,000 which was allocated to the same purpose in the preceding year. How the money, particularly that set aside for the payment of bonuses and for profit-sharing, is divided, it is impossible to say, and the information could probably only be revealed by the companies themselves. The figures certainly show that a very considerable sum is devoted to the interests of the staff and workpeople, although it may be assumed, rightly or wrongly, that the pension fund includes the legal provision in respect of compulsory insurance against old age and illness. On the other hand, some interest may be manifested in the question of the directors' remuneration, and the figures are given below:—

Directors' Fees.

	1906-7.	1905-6.
Allgemeine Co.	£20,000	£15,575
Siemens & Halske	12,360	10,195
Siemens-Schuckert	—	—

The exact amount paid as fees in the case of the Siemens-Schuckert Works has not been disclosed. In the case of the other two companies, the sum divisible among the members of each of the boards is very handsome, but at the same time it does not seem out of proportion either to the magnitude of the turnover, the amount distributed among the officials and workmen, or to the profits received by the shareholders in each of the undertakings in question.

Gas Explosion.—A serious gas explosion occurred at Bradford on Monday morning, four houses being wrecked as a result. It appears that gas escaping from a street main found its way into the houses.

Water Treatment with Barium Salts.—On the question of water softening, it has been pointed out that whereas lime could be best used for reducing temporary hardness, the use of soda to reduce permanent hardness involves the production of sodium sulphate, which remains in the water, being very soluble, until it concentrates to the point of crystallisation. It was, therefore, suggested that a barium salt might be employed. Barium carbonate is practically insoluble, and so is barium sulphate. Now, by putting barium carbonate into a water rendered hard by lime sulphate, the barium and the lime will exchange acids, the lime sulphate becoming a nearly insoluble lime carbonate, and the barium carbonate becoming an equally insoluble sulphate. Both products precipitate and leave a water practically pure. It is claimed that the barium carbonate, though not soluble, can be acted upon by the hard water to this effect, and that as it is insoluble, no care is needed in correctly proportioning the amount of the added reagent. Barium hydrate, which is soluble, may also be employed. This salt will also decompose lime sulphate with the production of lime (CaO), and this lime will serve to reduce any lime bicarbonate to the extent of the proper equivalent. The only bar to the use of the barium salts at present, apart from their poisonous qualities, is that they are too costly. It is expected that by electrolytic means the carbonate or hydrate of barium may before long be made so cheaply as to enable the salts to take the place of soda in water-softening, with the above advantage, that the water will be really cleared of its salts. The soda process for gypsum water is well known to leave a greater weight of salt in solution than was present before softening, with the difference that the new ingredient may concentrate very considerably before it deposits, and the concentration point will rarely occur with care and attention. All the soda salts are so soluble that there is no means of removing them from solution except by concentration. The treatment with barium should come into use if barium salts can be produced at a cheap rate.

Mendeléeff Congress in St. Petersburg.—The *Times* states that the first meeting of a Physico-Chemical Congress, instituted in honour of the great Russian chemist Mendeléeff, who died in February last, has just been held in St. Petersburg. It has addressed a special greeting to Sir James Dewar, both on the ground of Mendeléeff's personal friendship and admiration, and on that of his position as resident manager of the Royal Institution, of which Mendeléeff was proud of being an honorary member.

Test of an Ozoniser.—A statement of the efficiency of an ozoniser should give the amount of ozone produced by a given amount of electricity and also the amount produced by a given quantity of electrical energy. Both should be given for different ozone concentrations, since the efficiency varies greatly with this factor. The first test requires a knowledge of the current employed, the time, and the amount of ozone produced, while with the second the pressure applied to the ozoniser and the power factor of the alternating current must be known. With an alternating current the electrical power can best be determined by measuring the watts at the primary of the transformer and subtracting the transformer losses. The latter must be small, for accurate measurements, and as a consequence the transformer should operate the ozoniser at about its own normal pressure and output. One of the most efficient types consists of narrow, bare electrodes, fitting into each other from two main leads placed on opposite sides, each pair of electrodes being separated by a dielectric of glass. The air to be treated for the test is washed in potassium permanganate, dried and measured. The ozone percentage is estimated by means of potassium iodide and titration with sodium thiosulphate. The current in the ozoniser is measured with a Kelvin electrostatic voltmeter from the fall of E.M.F. across a known non-inductive resistance. On the primary side of the transformer the pressure is measured with a similar instrument, the current with a Hoyt ammeter and the watts on a Thomson instrument. With the ozoniser described above, the yield of ozone in grammes per coulomb varies between 0·088 and 0·115 grammes, while the kilowatt-hour yield is 16 to 56 grammes. This piece of apparatus was designed for the Galpin laboratories, Fifty-seventh Street and Sixth Avenue, New York City. Such a test as this might with profit be made with any ozoniser, for it is quite well known that small variations in the working conditions make enormous differences in the efficiency of the apparatus.—*Electrochemical and Metallurgical Industry*, Vol. V, No. 7.

Institution and Lecture Notes.—Royal Society.—Yesterday, Thursday, the following papers, among others, were to be read:—

Dr. W. E. Sumpner: "Alternate Current Measurement." Communicated by Prof. J. Perry, F.R.S.

Hon. C. A. Parsons, C.B., F.R.S., and A. A. Campbell Swinton: "The Conversion of Diamond into Coke in High Vacuum by Cathode Rays."

Prof. C. S. Myers and Prof. H. A. Wilson, F.R.S.: "On the Perception of the Direction of Sound."

Dr. G. H. Burch, F.R.S., J. E. Marsh, F.R.S., and R. de J. F. Struthers: "Preliminary Note on Certain Phenomena of the Electric Discharge through Rarefied Nitrogen."

Faraday House.—The following special courses of lectures have been arranged:—Mr. Robert Hammond, "Electrical Legislation," commenced January 15th; Prof. C. A. Carus-Wilson, on "Dynamo Design," commencing January 20th; Mr. W. R. Cooper, on "Secondary Batteries," commenced January 14th.

Institution of Electrical Engineers.—At the last meeting of the Institution, held on the 9th inst., it was announced that Lieut.-Col. R. E. Crompton, C.B. (Past President), had been unanimously elected President for the remainder of the present Session. Lieut.-Col. Crompton, on taking the chair, referred briefly to his long association with the late Lord Kelvin, and the loss sustained by the Institution and electrical world generally, through his death.

Institution of Electrical Engineers (Manchester Section).—Special notice has been issued cancelling the meeting announced on the syllabus for January 21st, when Mr. C. H. K. Chamen was to have read a paper on "High-Voltage Transmission and Distribution." "Unforeseen circumstances" are blamed, and no meeting will now be held on that date.

Institution of Electrical Engineers (Glasgow Section).—The annual smoking concert is to be held at the Grosvenor on Saturday, February 1st.

Finsbury Technical College, O.S.A.—A dance will take place on February 15th. Tickets should be applied for as early as possible.

Automobile Trophy.—A valuable trophy has been presented to the Royal Automobile Club, by Mr. Mervyn O'Gorman, to be raced for annually by self-propelled vehicles of all nations. The distance run is to be not less than 100 miles, and the arrangements are to be in the hands of the Brooklands Automobile Racing Club; the opportunity will be afforded for attempting to break all records from 1 to 100 miles, as well as the 1-hour record.

Appointments Vacant.—Resident assistant engineer for the Workhouse Infirmary at Willesden (£52 +); engineer and manager of the Neath R.D.C.'s electric lighting system (£200).

Electrical Contractors' Association at Burnley.—The contractors, &c., of Burnley and district have formed the Burnley and District Electrical Contractors' Association, with Mr. Simpson (Simpson Bros., of Hapton) as president. Mr. J. F. Coates, of 18, Hebrew Road, Burnley, has been appointed secretary.

The Suggested German Electricity Monopoly.—The idea of establishing an Imperial monopoly of electricity supply is now stated to be warmly denied in Government circles, particularly by the Home Office authorities, who have washed their hands in innocence and repudiated any such imputation. It appears, however, that the South German States, and especially Bavaria,

have slightly anticipated the Imperial Government in the matter, and have already laid their hands on the problem, so as to work it for their individual benefit. The Government of Baden has appointed a committee to consider the question of creating an electricity monopoly for the Grand Duchy, and a site is declared to have already been selected for the erection of hydro-electric works, to be operated for the advantage of the revenue of Baden. The water-power of the Neckar, which was utilised in connection with the now historical transmission from Lauffen to Frankfort-on-Maine in 1890, is also to be requisitioned by the Government of Wurtemberg.

Telephotography.—A paper on this subject by Dr. F. Korn, the inventor of the system which bears his name for the electrical transmission of photographs, was recently read before the Bavarian Section of the Association of Engineers at Munich. After describing his system and its developments since 1902, the author referred to the recent experiments in telephotography between Berlin and Paris and between Paris and London. The next trials will take place between Berlin and London *vid* Paris, and both the telephone circuits represented by Berlin-Paris and Paris-London will be connected together in the Paris section, where it will be possible, it is said, to "pick up" simultaneously, the portrait being transmitted from Berlin to London. The Munich station, which has already worked with Berlin, will be firmly equipped in a few days for regular traffic, and it will, perhaps, yet be possible during the winter to exchange photographs also between Munich and Paris *via* Berlin, or even between Munich and London *via* Berlin and Paris. It is proposed, in 1909, to add to the four existing stations the cities of Copenhagen and Stockholm, and other European stations will also be included in the scheme. Dr. Korn proceeded to remark that when the results of the first successful experiments were known, the question arose as to whether the employment of telephotography held out the prospect of the permanent maintenance of stations, or whether the apparatus would simply remain a scientific toy. The author thought, from the beginning, of the possible application of the system to the use of the criminal investigation, police, and of the illustrated newspapers. Both now employ the method, and more extended uses are to be expected. The idea is that it may be utilised for purposes of a more private nature, as in the case of shipwrecks or railway accidents, in which portraits of injured persons might be sent to the nearest telephotographic station, and then forwarded to their friends, so that they could hasten to the scene. A further possible application lies in the introduction of telephotographic picture postcards. The next problem to solve by means of improvements is to insert more details in the photographs, so that not only portraits, but also groups and landscapes, may be transmitted. The question of the length of the cable will follow in order that photographs may be exchanged between Europe and America, and steps will then be taken to accelerate the method, so that less than six minutes will be necessary for the transmission of a photograph.

Hanley Electricity Department.—The third annual supper of the staff of the Hanley electricity works was held on Thursday, 9th inst., when a large number of the staff, supported by local contractors and electrical friends, were present. Mr. Alderman Coates (chairman of the Electric Lighting Committee) being unavoidably prevented from attending, the chair was taken by Mr. Councillor Schofield (vice-chairman). The toast, "Success to the Hanley Electricity Supply," proposed by Mr. Chas. Osborne (Blackburn, Starling & Co., Ltd.), was responded to by Mr. C. H. Yeaman, chief engineer, who stated that the working cost for the last four years had varied but little, notwithstanding a large increase in output. For 1903 it was £5,160; 1904, £5,685; 1905, £5,125; and for 1906, £5,131. The gross working expenditure since the start had been £55,438, and including management, &c., £74,024. Added to this were interest payments of £25,528, and repayments of loans aggregating £22,680, while the total receipts during the 12 years of operation came to over an eighth of a million pounds. This sum represented a sale of 8,000,000 units, and a quarter more than that were generated in addition. The aggregate profits were roughly £8,600, and losses £3,600, having a surplus balance of about £5,000, earned by trading during the period of supply. Wages amounted to £11,378, and salaries £8,478, so that labour received nearly £20,000 benefit by the establishment of the works. Mr. Yeaman also stated that he had never had a better staff, nor one which showed more enthusiasm, and now that the competition fight between gas and electricity was keen, and likely to become more keen, there was plenty of scope for the strenuous life, and he believed that pulling together with courage in the prow, prudence on the bridge, and well ballasted with a substantial reserve fund, and backed by a governing body entirely at one with the management, the good ship would weather the storm and come gaily sailing into the port of success. In any case, the town, as a whole, got the benefit. Electric lighting to-day only cost one-third of what it did three years ago in Hanley, owing to new lamps and reductions in the price of current, so that the craving for cheapness could be met while giving a decidedly good article. "Contractors and experts," proposed by Mr. Marston, mains superintendent, was very aptly responded to by Mr. Hulse (representing the British Westinghouse Co., Ltd.) and Mr. Barkham (representing the Union Electric Co., Ltd. "Local Engineering Visitors," proposed by Mr. Paddy, was responded to by Mr. C. Osborne. "Our latest arrival," (Mr. C. W. Charlesworth) proposed by Mr. C. H. Yeaman, was duly responded to. "Success to Howden's No. 1 engine," lately installed at the Hanley works, proposed by Mr. Horobin, was heartily responded to by Mr. Walker (Howden's, Ltd.). Songs, pianoforte and gramaphone solos were rendered by members of the staff and visitors.

Parliamentary.—*Standing Orders.*—The examiners have fixed January 18th as the first day for considering proofs of standing orders in regard to private Bills promoted this Session.

Lanarkshire Tramways.—The Lanarkshire Tramways Co. (incorporated under the name of the Hamilton, Motherwell and Wishaw Tramways Co. in 1900) and who are authorised to construct tramways in that district, are asking this Session by an order under the Private Legislation Procedure (Scotland) Act for an extension of time for the purchase of lands and completion of works, and also for power to the Motherwell Corporation to supply water to their generating station. They are also asking for power to raise £150,000 additional capital.

Motherwell Electricity Undertaking.—The municipality of Motherwell is promoting a provisional order this Session which will enable it, amongst other things, to supply electric fittings and to allow discount to consumers who pay their accounts within a given time.

Loch Leven Water and Electric Power Co.—This company is coming before Parliament in the ensuing Session for an extension of time for the completion of certain authorised works.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Officials.—MR. C. A. L. PRUSMANN, borough electrical engineer at Swansea, has been granted leave of absence for two months owing to ill-health. MR. G. H. THOMPSON, assistant engineer, will act for him during his absence.

Kirkcaldy T.C. has offered MR. O. F. FRANCIS, who has been appointed electrical engineer at Carlisle, an addition of £50 to his salary, making it £350 per annum, with two further annual increments of £25, in order to induce him to retain his present position.

MR. F. CLOUGH has been presented with a travelling bag and hand bag by the staff of the Bradford Corporation electricity department on his leaving to take up an appointment under the Worcester C.C. at Bromsgrove Asylum.

Tramway Officials.—The employés of the Lincoln Tramway Department held their annual supper on the night of the 7th inst. between 11.30 p.m. and the time of starting the service for the following day. MR. S. CLEGG, the electricity works engineer, was among those present, and he responded to the toast "Prosperity to the Tramway Undertaking."

General.—On January 8th MR. GEORGE W. FORES, an employé at the works of Messrs. Evershed & Vignoles, Chiswick, was presented with an illuminated address, together with a purse of gold, by the Hanwell and District Parliament, with the formation of which, four years ago, he was prominently identified, and in which he is still "Clerk of the House." The presentation took place at the Park Hotel, Hanwell.

MR. W. E. POTT, late of the Army and Navy Auxiliary Co-operative Supply, Ltd., Westminster, electrical department, has resigned his position with that company to take up the position of general manager to Messrs. Krupka & Jacoby.

The National Telephone staff at Barnstaple has presented a walking stick to MR. WILKINSON, district manager, on his departure for Truro. Mr. Wilkinson is succeeded at Barnstaple by MR. C. M. FRENCH, of Truro.

MR. W. KIRKHAM, late of Messrs. W. T. Glover & Co., Ltd. (contract department), has now joined the staff of Messrs. Siemens Bros. Dynamo Works, Ltd., at their Manchester branch, 196, Deansgate, Manchester.

On Wednesday, at St. Mary Abbot's, Kensington, the wedding took place of MR. S. G. BROWN, so well known as an inventor of submarine telegraph apparatus, and Miss Alice Mary Herbert Russel Stower, niece of Prof. John Perry, F.R.S., who gave her away. Among those invited to the wedding were Sir W. and Lady Crookes, Sir John and Lady Pender, Sir Wm. Preece, Prof. and Mrs. Ayrton, and many others well known in the scientific world.

Obituary.—SIR FREDERICK JOHN GOLDSMID.—In the early hours of Sunday morning last there passed away at Brook Green, London, in the ninetieth year of his age, Major-General Sir Frederick John Goldsmid, K.C.S.I., C.B., a man of great attainments, who, in the course of his long life, had rendered services of great distinction under the old East India Co. and under the Indian Government. Of the many appointments as a commissioner and arbitrator, and of a military and diplomatic kind, in which he over and over again distinguished himself, of his fine knowledge of Oriental languages, and of his varied and remarkable attainments and achievements, the reader may read to his profit in the *Times* of Monday last, which contains a full account of the deceased gentleman's career, and in general literature; but it is more particularly Sir Frederick's work in the world of telegraphy and telegraphic administration to which we would refer here. It was some years after 1856 while he was displaying great tact and energy as a member of the staff of Sir Bartle Frere, then Chief Commissioner of the Scinde, that he was selected, because of his special fitness, to superintend the work of establishing overland telegraphic communication from Europe through Persia and Baluchistan to India.

He was also chief director of the Government on the Indo-European Telegraph service from 1865-1870, and in that absorbingly interesting and valuable volume published by him four years later —*Telegraphy and Travel*—was given an account of the erection of the system across the Shah's kingdom. The *Times* points out that in this book he rendered "full justice to the efforts of his assistants, saying little or nothing of his own." It is touches such as this that add so much to the admiration of the average Englishman for our great men. On several occasions during his life in India his health broke down, and he had to return home, but hardly had he reached these shores when he was ready to be off again somewhere else on some other duty. From active service of any kind, save his literary pursuits and his interest in philanthropic and religious organisations, Sir Frederick had been in retirement for about 25 years, owing to the complete breakdown of his health. During those years of retirement a new generation has arisen that learns of his achievements only at his death, but in the records of his life it will find many a great quality worthy alike of study and of emulation.

WILLIAM HARVIE.—We have learnt with regret of the death of Mr. William Harvie, of Wm. Harvie & Co., Ltd., M'Alpine Street, Glasgow, patent ship lamp manufacturers and electrical engineers, which took place at Glasgow on the 4th inst. Mr. Harvie was one of the pioneers of ship lighting by electricity on the Clyde, which at that time meant Scotland, and we understand that some of the earlier plant installed by him is still doing good service. He was one of the first, if not actually the first, and had few competitors in the early days. He was also one of the earliest manufacturers of dynamos on a commercial scale in Scotland, being only forestalled by Messrs. Mavor & Coulson. He was 78 years of age. For family reasons, the business was some time ago turned into a limited liability company, and it will be continued as it has been carried on hitherto.

J. MACFARLANE GRAY.—As we go to press, news comes to hand of the death of an eminent engineer and friend—Mr. J. Macfarlane Gray, late Chief Examiner of Engineers to the Board of Trade.

NEW COMPANIES REGISTERED.

Radyr Electric Co., Ltd. (95,997).—This company was registered on December 9th, with a capital of £2,000 in £1 shares, to carry on at Radyr, Glam., or elsewhere, the business of electricians, mechanical engineers, manufacturers and workers of and dealers in electricity, motive power and light, &c. The first subscribers (each with one share) are:—R. V. Nance, 2, Dock Chambers, Cardiff, electrical engineer, &c.; F. Ellams, 4, Ryder Street, Cardiff, manager; E. Thomas, 33, Connaught Road, Cardiff, merchant; W. A. Campbell, 31, Marlborough Road, Cardiff, accountant; H. J. Latch, The Laurels, Gabalca, Glam., accountant; H. F. H. Nance, 52, Gordom Road, Cardiff, manager; and H. Nance, 2, Dock Chambers, Cardiff, colliery agent. No initial public issue; the numbers of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification 50 shares; H. F. Thomas is the secretary.

Checkogram (1908), Ltd. (96,322).—This company was registered on January 3rd, with a capital of £51,000 in £1 shares, to acquire the undertaking of Checkogram, Ltd. (incorporated in 1904), to adopt an agreement with the said company and its liquidator, and to carry on the business of manufacturers of and dealers in mechanical and electrical appliances for delivering, receiving, counting, checking, or other operations, and mechanical and electrical indicators, turnstiles, gates, tickets, checks, perforating and stamping presses, lamps, alarms, contact makers, boxes, frames, cases, fibre, vulcanised fibre, vulcanite and the like, electricians, suppliers of electric or other power, engineers, &c. The first subscribers (each with one share) are:—W. B. Purefoy, 20, Jermyn Street, S.W., gentleman; W. Leon, Hazeldene, Maidenhead, gentleman; Col. C. W. Cox, 9, Oakwood Court, Kensington, W., retired; Capt. H. F. Darell, 3, Bennett Street, St. James', S.W.; W. Slark, 33, Southampton Street, Strand, W.C., solicitor; J. M. Cobban, 33, Southampton Street, Strand, W.C., solicitor; and P. H. Edwards, 33, Southampton Street, Strand, W.C., solicitor. No initial public issue. The number of directors is not to be less than three or more than seven; the first are W. B. Purefoy, W. M. Leon, C. W. Cox, and Capt. H. F. Darell; qualification, £500 shares or stock; remuneration, £400 per annum, and not more than £600 out of the surplus profits remaining in any year after providing for reserve fund, and for 20 per cent. on the ordinary shares, divisible. Registered office, 150, Oxford Street, W.

British Electrics (Moseley's Patents), Ltd. (96,266).—This company was registered on December 31st, with a capital of £10,000 in £1 shares, to acquire and turn to account inventions relating to the manufacture of electric, magnetic, telegraphic, telephonic and other appliances, and certain patents rights and other property referred to in an agreement dated November 19th, 1907, between W. Moseley and F. de H. Larpent, and with a view thereto to adopt an agreement with the said F. de H. Larpent. The first subscribers (each with one share) are:—J. J. Ireland, 104, Loughborough Park, S.W., advertising agent; A. G. Hastings, 42, Portland Road, Notting Hill, gentleman; A. Klein, The Hawthorns, Bramley Hill, Croydon, merchant; C. D. Moggridge, Woodcote, Lee-on-Solent, Hants, gentleman; R. H. Peren, 16, Rostrevor Mansions, Fulham, S.W., insurance broker; H. E. Luker, 8, Regent Street, S.W., clerk; and J. H. East, 8, Regent Street, S.W., clerk. No initial public issue; the number of directors is not to be less than three or more than five; the first are W. Moseley and others to be appointed by subscribers; remuneration, £100 each per annum (chairman, £150) and 10 per cent. of the profits remaining in any year after 10 per cent. dividend has been paid, divisible.

Mersey Machinery Co., Ltd. (96,399).—This company was registered on January 9th, with a capital of £1,500 in £1 shares (50 10 per cent. cumulative preference), to act as selling agents for the Neville Machine and Tool Co., Ltd., in Southport, Ormskirk, Bootle, Widnes, Newton, Ince, Liverpool, St. Helens, Warrington, Wigan, Wirral, Northwich, Eddisbury and Flintshire. The subscribers (with one share each) are:—J. U. Neville, 7, James Street, Liverpool, engineer; T. J. Knowles, Sunnyside, Woodend Park, Liverpool, engineer; Mrs. M. A. Knowles, Sunnyside, Woodend Park, Liverpool; R. Hughes, 30, Percy Road, Seacombe, Chester, broker; A. E. Waterhouse, 10, Rossett Avenue, Liverpool, clerk; E. D. Symond, 5, Harrington Street, Liverpool, solicitor; Mrs. M. E. Neville, Ruthergien, Hunts Cross, Liverpool. No initial public issue. The number of directors is not to be less than two or more than three; the first are J. U. Neville and T. J. Knowles. No remuneration. Registered office, 7, James Street, Liverpool.

A. B Carter & Co. (Germany), Ltd. (96,391).—This company was registered on January 9th, with a capital of £1,500 in £1 shares, to adopt an agreement with J. Wenk, of 107A, Strand, W.C., and to carry on the business of electricians, mechanical engineers, suppliers of electricity, manufacturers of and dealers in electric, magnetic, galvanic and other apparatus, builders, sign makers, printers, photographers, advertising agents, &c. The first subscribers (each with one share) are:—T. H. Bower, 4, Bream's Buildings, Chancery Lane, W.C., solicitor; J. Wenk, 182, Portsdown Road, Maida Vale, W., advertising contractor; G. C. N. Perkis, 29, Redcliffe Square, S.W., solicitor; G. R. Bell, 47, Torrington Square, W.C., solicitor; T. Hulme, 29, Courthope Villas, Wimbledon, S.W., solicitor; F. Partington, 31, Cecil Park, Crouch End, N., clerk; and C. Ivory, 198, Ebury Street, S.W., clerk. No initial public issue; J. Wenk is the first managing and permanent director; qualification, £150 shares or stock. Registered office, 107A, Strand, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

County of Durham Electrical Power Distribution Co., Ltd. (61,591).—A trust deed dated December 9th, 1907, to secure £250,000 5 per cent. first mortgage debenture stock, with power to increase to £500,000 (the deed being stamped to cover £500,000) has been registered. Property charged—(specifically): Certain electrical undertakings, constituted by provisional orders, with premises, mains, rolling stock, plant and appurtenances, certain freehold, leasehold and copyhold hereditaments, with fixed plant and machinery on the freehold property, 14,431 £10 shares in the County of Durham Electric Power Supply Co., and any other shares in the same company which may be acquired by this company. (As a floating security): the company's undertaking and general assets, present and future, except specifically mortgaged premises and uncalled capital. Trustees: Law Debenture Corporation, 41, Threadneedle Street, E.C.

Cammell, Laird & Co., Ltd. (Sheffield).—A trust deed dated December 19th, 1907, to secure £500,000 5 per cent. debenture stock, has been registered. Property charged: Certain lands, hereditaments, and the company's undertaking and other assets, including uncalled capital, subject as to certain portions thereof to £2,000,000 mortgage debentures secured by trust deeds of various dates from November 30th, 1898, to November 6th, 1906. Trustees: E. B. Merriman, 9, Hyde Park Gardens, W.; and J. Wortley, Sheffield.

Egyptian Delta Light Railways, Ltd. (51,516).—A trust deed dated December 23rd, 1907, securing a further £25,000 debentures (supplemental to a trust deed of March 25th, 1897, securing £170,000 debentures, and to trust deeds of July 25th, 1900, March 7th, 1904, June 8th, 1904, and September 17th, 1907, securing respectively £100,000, £60,000, £180,000 and £20,000 additional debentures) has been registered, making the total amount secured £505,000. Property charged: All the company's securities, railways, undertaking and property, present and future (subject, as to property purchased from La Compagnie des Chemins de Fer Economiques de l'Est Egyptien, to £242,180 3½ per cent. debentures, and subject also, as to property purchased from the Metropolitan and Cairo Helouan Railway Société Anonyme, to £E96,000 4 per cent. debentures). Trustees: Sir Gerald Fitzgerald, K.C.M.G., 28, Cadogan Gardens, S.W.; and Sir John R. Heron-Maxwell, Bart., 9, Wilbraham Place, London.

Cleveland and Durham Electric Power Co., Ltd. (89,539).—Issue on December 11th of £105,000 5 per cent. debentures, being the whole of a series created same date. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. (The charge for £5,000 in favour of Sir Hugh Bell, Bart., and Sir John D. Milburn, Bart., is now cancelled.)

Bastian Meter Co., Ltd. (Kentish Town) (53,304).—Issue on December 31st of £1,000 6 per cent. debentures, part of series created August 4th, 1905, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: J. W. Salisbury, Limerick Hall, Harpenden, Herts; and Miss E. Orme, 118, Upper Tulse Hill, S.W. Previously issued of same series: £4,900.

Joseph Evans & Sons (Wolverhampton), Ltd. (Hydraulic, Electric and General Engineers) (95,446).—£50,000 6 per cent. debentures, created and dated December 18th, 1907, have been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

A. W. Penrose & Co., Ltd. (photographic and electrical apparatus manufacturers, London) (86,209).—A memorandum of satisfaction, to the extent of £2,000, of debentures dated October 27th, 1905, and covered by a trust deed of even date, securing £10,000, has been filed.

Electromobile Hiring Co., Ltd. (83,703).—This company's annual return was filed on November 26th, when the entire capital of £12,000 in £1 shares had been taken up. £6,004 has been received and £5,996 is considered as paid. Mortgages and charges: Nil.

Flather & Co., Ltd. (74,602).—This company's annual return was filed on November 11th, when 1,527 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £27 has been received, and £1,500 is considered as paid. Mortgages and charges: £1,000.

Railway and Tramway Trust, Ltd. (89,684).—This company's annual return was filed on January 2nd, when the entire capital of £2,000 in 1s. shares had been taken up. £1,112 has been received, and £888 is considered as paid. Mortgages and charges: Nil.

Universal Electrical Supply Co., Ltd. (93,507).—The statutory report, dated November 7th (filed November 18th), shows that the entire capital of £1,000 in £1 shares has been taken up. £7 has been received, and £993 is considered as paid. No mortgages or charges registered.

Lowden Electric Lamp Co., Ltd. (Acton Green), (83,470).—A debenture dated December 18th, 1907, to secure £350, charged on the company's undertaking and property, including uncalled and unpaid capital, has been registered. Holders: British Westinghouse Electric and Manufacturing Co., Ltd., 2, Norfolk Street, W.C.

Connolly Brothers, Ltd. (Electricians, Blackley), (44,277).—Particulars of £7,500 second mortgage debentures, created by resolution of December 16th, 1907, and secured by a supplemental trust deed dated December 18th, 1907 (having also, subject to the rights of the first mortgage debenture holders, the benefit of the original trust deed of July 15th, 1901, covering £30,000 first mortgage debentures), have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. The said supplemental trust deed has also been registered. Property charged:—The company's undertaking and property, present and future, including uncalled capital, subject to first mortgage debentures. Trustees: Liverpool Mortgage Insurance Co., Ltd., and J. W. Davidson, both of 6, Castle Street, Liverpool.

Lancashire Light Railways Co., Ltd. (57,018).—A mortgage dated January 1st, 1908, to secure £9,000 (supplemental to and transferring the charge created by an indenture dated June 29th, 1907, covering £6,000, and securing a further £3,000) has been registered. Property charged: All moneys due or to become due under a working agreement with the St. Helens and District Tramways Co.; all moneys, shares, securities or other consideration to which the company may become entitled as the purchase money in respect of any sale of its railway property or undertaking, or part thereof; the company's railway and any extension thereof, with all tolls, rates and charges for the time being, authorised to be demanded or charged in respect thereof, and the company's undertaking and property, present and future, including uncalled capital (subject, as regards railway, &c., to any working agreement). Holders: Lancashire United Tramways, Ltd., Atherton.

CITY NOTES.

The British Westinghouse Electric and Manufacturing Co., Ltd.

THE following is a copy of a circular which has been issued by the board to the shareholders, under date January 4th, concerning the position of the company:—

The directors had prepared and were about to issue a communication to the shareholders, when the conditions in the United States made it necessary to temporarily place the American companies under the protection of the Courts. It, thereupon, became desirable to await the outcome of important proceedings, which the directors believed necessary for the best interests of the property before issuing the communication in question. The American company had, heretofore, either itself furnished the financial assistance needed by this company, or acted as its guarantor, and as that company was unable, under the circumstances, to contribute to our requirements, it became necessary for the directors to make other arrangements for meeting present needs. Under the existing conditions of the money market it would have been impossible to raise money by the issue either of shares or debenture stock ranking *pari passu* with the existing debenture stock, and it was therefore found necessary to make an issue of prior lien debentures. At a meeting of the debenture stockholders, held on December 18th, an issue of £300,000 of such debentures was authorised. In order that the whole of this amount might be available for present and future needs, the American companies agreed to accept in liquidation of the £186,374 owed to them, Traction and Power Securities Co. shares (an asset of the company) at par. The £300,000 of prior lien debentures is required as follows:—

To repay advances from bankers expected to be reduced by February and March to	£100,000
To meet accounts payable, now due	110,000
To meet additional requirements on account of expansion of business	90,000
	£300,000

The directors have had under consideration for some time the changing, from July 31st to December 31st, of the termination of the financial year, as experience has shown July 31st to be an inconvenient date for closing the books and taking the necessary inventories, and they have decided to make the change now. The proceedings at the close of 1906, connected with the reduction of capital, have rendered this change additionally desirable, as that reduction was based upon figures established on December 31st of that year. The next accounts to be presented to the shareholders under the new arrangement will cover two periods, one of five months from August 1st, 1906, to December 31st, 1906, and another from January 1st, 1907, to December 31st, 1907. The annual general meeting for the consideration of these accounts will be held as soon after the close of the financial year as possible. In the meantime, the accompanying figures show substantially the position at November 30th.

ASSETS.

Cash at bankers		£22,994
Cash with cashiers, agents and others		3,229
Sundry debtors, less reserve for bad and doubtful debts		461,727
Materials, supplies, apparatus in process of manufacture and finished product		555,423
Shares and debentures in other companies:—		
20,079 shares of the Clyde Valley Electric Power Co., Ltd., of £10 each	£200,790	
25,000 shares of the Traction and Power Securities Co., Ltd., of £10 each	250,000	
Sundry written down to	31,487	
		482,277
Works, machinery, plant, tools, patterns, &c., written down as at December 31st, 1906, to	£1,708,933	
Additions to November 30th, 1907	4,840	
		1,713,755
Patents, goodwill, &c., written down to		375,000
Patent renewal fees, insurance, &c., paid in advance		15,096
		£3,629,521

LIABILITIES.

Four per cent. mortgage debenture stock		£1,241,353
Interest accrued thereon		19,655
Loans from bankers		182,052
American Westinghouse Companies:—		
For loans	£140,000	
,, Goods, &c.	46,374	
		186,374
Sundry creditors		150,636
Reserve for employers' liability		6,671
Total liabilities		£1,736,741
Share capital:—		
75,000 ordinary shares of £5 each	£375,000	
500,000 10 per cent. preference shares of £3 each	1,500,000	
Profits accrued to date	17,780	
		1,892,780
		£3,629,521

The 11 months of the present year show a trading profit of £76,000 and a net profit of £17,780 after providing for interest on loans and debenture interest. The accounts and business of the company will be dealt with in detail at the annual general meeting, but it will be seen that there has been a considerable improvement in the affairs of the company, and the directors believe that if there be no unfavourable development in industrial conditions the position of the company will continue to improve. In the meantime, the arrangements made have enabled the company's business to be protected and the interest to be punctually paid to the debenture stockholders.

Western Union Telegraph Co.

THE quarterly report of this company to September 30th, 1907, shows that after providing for interim dividend and interest on bonded debt, there was a surplus of $14,923,200 (£2,984,640). Estimating the net revenue for the quarter ending December 31st, 1907, at $1,000,000 (£200,000), and appropriating $1,650,085 (£330,017) for dividend and interest (as above), the surplus at the end of the year amounted to $14.273,113 (£2,854,622).

The quarter to September 30th, 1907, showed a deficiency of $311,493 (£62,298), and the quarter to December last was also unsatisfactory. These results are traceable to the strike of operators, as the following extract from the report in the *Journal of the Telegraph* will show:—

"The strike extended to all parts of the country, the aim of the strikers being to force the company to recognise and deal with the Telegraphers' Union, maintain a closed shop, and thus practically transfer the management of the business to the officers of that organisation. In fact, so certain were they of success that they planned the details of the management, the salaries to be paid, the hours of service, and marked various officers of the company for dismissal from their positions. For some time previous to the strike, many of the operators in the company's employment deliberately delayed the transmission of traffic, handling 25 to 40 per cent. less business than that now handled by loyal employés of the same ability on similar wire circuits. A sufficient number of loyal operators remained in the service to remove the decreased traffic, and stood faithfully at their posts, notwithstanding the interference in every possible way of the strikers by crippling wires, picketing, abusing and assaulting the faithful employés. The ranks of the loyal operators were gradually supplemented by additions to the force; the strike was completely and thoroughly defeated, and such strikers as were re-tored to the service were accepted on individual applications and with the distinct understanding that in future they must be single in their allegiance to their employer.

"Sufficient returns have been received from the offices by this time to show that the revenues of the company were greatly decreased during the strike, and, owing to the depression of business which set in at the time the strike closed, the decrease has continued up to the present. The expenses of the company were largely increased by the 10 per cent. advance in the pay of all operators from March 1st, 1907. This increase was voluntarily granted to the operators without the knowledge of the union, and influenced a large number of them to remain loyal in the service. In addition to the loss of revenue caused by the falling off of business, and to the increase in expenses caused by the 10 per cent. increase in salaries, a very large expense was necessitated by the extra pay or bonus allowed the loyal operators and linemen during the strike, and by the cost of board and lodging which were furnished free to employés who ate and slept in the operating departments or adjoining rooms. These employés rendered heroic service day and night during the strike, and have all been retained in their positions.

"The property of the company is in first-class condition throughout the entire country; the present employés are faithful and efficient, and, with the passing of the financial depression, our revenues will rapidly increase.

"Although it is believed, as indicated, that business will soon resume and earnings become normal, nevertheless, in view of the present depression, it seems the part of conservatism not to pay cash, but to make a dividend of 1 and 1¼ per cent., payable in stock."

The Westinghouse Companies.—A Reuter despatch from Pittsburg, dated January 11th, says that the United States Judge has issued an order permitting the receivers of the Westinghouse Electric and Manufacturing Co. to exchange a claim of $874,882 against the British Westinghouse Electric and Manufacturing Co., Ltd., for shares in the Traction and Power Securities Co., Ltd., of Great Britain, equal at par to the same amount and interest, provided that the British Westinghouse Electric and Manufacturing Co., Ltd., secures *bona-fide* subscriptions for a bond issue of £250,000. A Central News despatch from New York on the same day stated that the main feature of the plan for the reorganisation of the Westinghouse Corporation would be the issue of $45,000,000 mortgage bonds.

Mexico Tramways Co.—A dividend at the rate of 4 per cent. per annum for the three months ended December 31st, 1907, has been declared.

Okonite, Ltd.—An interim dividend of 8 per cent. per annum (1s. per share), less income-tax, has been declared on the ordinary shares for the quarter ended December 31st, 1907.

Brazilian Rubber Plantations and Estates Co., Ltd.—This company at a special meeting held on 13th inst. passed a resolution to wind up voluntarily, with a view to reconstruction with a smaller capital—namely, £116,000 instead of £180,000. Some in the meeting strongly pressed for compulsory liquidation. The *Times* makes the following comment upon the matter:—"The demand for compulsory liquidation and consequent public investigation appears to have a good deal of reason behind it. It was stated at the meeting, without contradiction by the board, that the company had paid £150,000 for the property, which was sold by the owners for £15,000."

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Jan. 6	2,854	+ 115	32	45,814	— 1,264	14·4	..
Ayr	,, 11	392	+ 6	35	11,115	— 95	8	..
Bath	,, 8	1,184	— 76	2	..	..	13	..
Belfast	,, 10	6,537	+ 270	41	159,585	+ 9,684	36	..
Birkenhead	,, 12	1,993	— 91	40	43,627	..	13·53	..
Birmingham Corp.	,, 4	13,045	..	40	247,740	..	56·46	..
†Blackburn	,, 1	1,103	— 90	40½	45,286	+ 3,075	14·13	..
Blackpool Corp.	,, 9	691	+ 8	..	48,338	— 1,224	11·87	..
† ,, —Fleetw'd.	,, 11	180	+ 4	52	23,323	— 819	8·25	..
Bolton	,, 12	4,679	+ 156	41	93,661	+ 5,789	26	..
Bournemouth	,, 8	2,757	+ 91	40½	70,243	+ 1,593	21·5	..
†Bradford	,, 4	4,155	+ 46	40	186,528	+ 4,303	54·9	1
Brighton	,, 12	1,302	— 192	41	37,759	— 3,173	9·6	..
Bristol	,, 10	9,041	— 343	..	..	..	23·6	..
†Brit. Elec. Trac. Co.								
Airdrie	,, 3	327	+ 49	52	11,734	+ 83	3·65	..
Barnsley	,, 3	168	+ 17	,,	8,779	+ 280	..	..
Barrow	,, 3	205	— 8	,,	13,302	— 133	5·87	..
Cavehill	,, 3	50	+ 14	,,	4,304	— 221	..	..
Devonport	,, 3	422	— 11	,,	21,824	— 176	8·85	..
Gateshead	,, 3	1,070	+ 123	,,	52,780	+ 1,595	11·26	..
Gravesend	,, 3	186	+ 10	,,	12,694	+ 82	6·5	..
Greenock	,, 3	571	— 39	,,	33,445	— 734	7·25	..
Hartlepool	,, 3	254	— 15	,,	14,942	— 575	6·72	..
Kidderminster	,, 3	102	+ 19	,,	6,166	— 46	..	..
Leamington	,, 3	122	— 20	,,	8,368	— 548	3	..
Merthyr	,, 3	197	+ 19	,,	11,104	+ 633	2·9	..
Metropolitan	,, 3	4,469	+1,205	,,	244,198	+64,783	22	..
Middleton	,, 3	308	+ 71	,,	18,244	+ 174	5·5	..
Mid. Joint Com'tee	,, 3	5,877	+ 110	,,	306,732	+ 4,751	..	..
Oldham—Ashton	,, 3	231	+ 23	,,	32,813	+ 1,548	9·13	..
Peterborough	,, 3	112	+ 18	,,	6,655	— 55	5·31	..
Potteries	,, 3	1,669	— 187	,,	99,268	+ 3,179	29	..
Rothesay	,, 3	83	..	,,	10,381	— 650	2·75	..
Southport	,, 3	191	+ 26	,,	15,893	— 665	8·17	..
S. Metropolitan	,, 3	608	..	,,	41,472	..	..	..
Swansea	,, 3	771	+ 82	,,	47,987	+ 3,477	5·5	..
Tynemouth	,, 3	173	+ 19	,,	12,230	— 749	3·75	..
Weston-s-Mare	,, 1	29	+ 2	,,	7,136	— 367	3	..
‡Worcester	,, 3	231	— 3	,,	24,753	— 89	5·75	..
Wrexham	,, 3	89	— 8	,,	5,350	— 85	..	..
Yorks. Wool. Dist.	,, 3	834	+ 15	,,	48,469	+ 941	17	..
Miscellaneous	,, 3	212	+ 21	,,	11,606	— 153	..	..
Burnley	,, 11	2,383	— 6	..	..	..	7·5	..
Burton-on-Trent	,, 12	481	— 55	41	11,705	— 605	11	1·5
†Bury	,, 5	1,235	+ 287	40	44,941	+ 5,539	10·5	..
Cardiff	,, 4	3,984	+ 26	40	86,500	+ 2,378	15·87	..
Carlisle	,, 11	300	— 20	..	..	..	..	..
†Chatham and Dist.	,, 9	759	— 196	52	37,633	+ 1,580	13·16	·68
†Cork	,, 9	374	— 50	1⅞	479	— 121	9·89	..
Croydon	,, 10	2,291	— 173	41	58,204	— 1,689	12	·75
Darlington	,, 11	385	+ 5	41	8,737	+ 31	..	..
Darwen	,, 10	458	— 27	41	10,484	— 43	4·36	..
Dover	,, 4	339	— 23	40	9,213	— 1,159	4·75	..
†Dublin	,, 10	4,754	+ 255	52	170,612	+32,033	54·25	5·5
Dundee	,, 8	2,652	+ 271	34	+9,523	+ 1,566	14·5	..
East Ham	,, 11	1,717	+ 78	41	37,439	+ 879	7·75	..
†Exeter	,, 6	240	— 12	36	11,507	+ 5·1	4·75	.5
Glasgow	,, 11	35,005	+ 227	31½	564,690	+16,015	39·25	5·5
Hastings	,, 9	1,413	..	..	..	..	..	..
Huddersfield	Dec. 28	3,110	+ 320	39	69,578	+ 2,989	28	..
Hull	Jan. 11	4,976	+ 278	41	101,671	+ 5,744	18	..
Ilkeston	,, 8	239	+ 15	41	5,855	+ 370	3·5	..
Ipswich	,, 11	592	— 52	41	16,620	— 1,066	10·5	..
†Isle of Thanet	,, 4	199	— 16	..	..	..	11	..
Kilmarnock	,, 11	356	— 28	34	8,503	— 196	14·13	..
†Lan'kshire Trm Co.	,, 9	1 285	+ 412	52	63,543	+17,154	15·82	3·26
†Lancashire United	,, 8	1,037	+ 63	52	66,492	+15,064	39	1
Leeds	,, 4	13,056	+ 888	40	262,796	+11,494	51·13	..
Leicester	,, 11	4,076	— 96	..	..	..	..	..
Leith	,, 4	1,097	+ 66	33½	17,797	+ 127	6	..
†Liverpool	,, 4	10,124	— 680	52	568,081	+ 8,3556	104	..
‡L.C.C.	Dec. 28	68,682	+16,286	39	1,225,166	+205,24	116·5	10
†London United	Jan. 11	4,845	— 526	..	..	..	..	..
Lowestoft	Dec. 28	397	+ 94	13	2,254	+ 98	3·5	..
Manchester	Jan. 11	26,791	+ 928	41	607,088	+40,918	86	11
Newcastle	,, 11	7,824	+ 75	41	168,334	+ 1,204	..	..
Newport	,, 11	1,122	+ 7	41	28,146	+ 2,043	14·5	..
Northampton	,, 10	752	+ 34	39½	17,791	— 352	5·5	..
Oldham	,, 12	3.400	+ 38	41	79,609	+ 5,609	23·75	..
†Pontypridd	,, 4	255	+ 99	40	10,930	+ 4,190	5	1·75
Portsmouth	,, 11	2,974	— 186	41	81,947	— 1,496	14·5	..
Preston	,, 8	1,362	+ 46	..	..	..	..	..
†Reading	,, 9	547	— 95	40½	25,481	— 730	12·25	..
Rotherham	,, 9	1,157	+ 193	40½	24,966	+ 4,062	10	·66
Salford	,, 5	9,087	+1,411	40	187,363	+ 6,016	38·9	..
Sheffield	,, 12	10,714	+ 109	42	234,669	+10,722	35·75	..
Southampton	,, 8	1,830	+ 145	40½	42,149	+ 2,374	..	..
Southend-on-Sea	,, 8	488	+ 20	41	16,790	+ 84	..	..
Sunderland	,, 12	2,425	— 197	41	56,648	— 1,378	..	..
Swindon	,, 1	333	+ 10	..	..	..	4·4	..
†Tyneside	,, 8	346	+ 3	..	..	..	9·67	..
Wallasey	,, 11	1,425	— 81	41	34,554	+ 645	3·72	·22
Walthamstow	,, 11	900	+ 60	41	24,989	+ 1,066	9	..
West Ham	,, 9	4.184	— 36	41	95,088	+ 2,110	14·7	..
Wolverhampton	,, 8	1,671	+ 220	40	37,734	+ 487	19·5	..
†Yorks. W. Riding	,, 8	1 084	+ 87	49	56,924	..	..	..
Baker St.-Waterloo	,, 11	6,510	+1,780	..	..	..	4·25	1
Cen. London Rly.	,, 11	12 512	— 345	..	..	..	6	..
Char. +, Eus. Hamp.	,, 11	6.860	..	..	..	..	7·75	..
City & S. Lon. Rly.	,, 12	7,191	+ 907	..	..	..	7 5	1·05
Dublin-Lucan Rly.	,, 10	124	— 19	26	3,606	+ 227	7	..
G.N. and City Rly.	,, 11	3,692	— 170	..	..	..	3½	..
G.N., P'dy. & Brmp.	,, 11	10,835	+3,845	..	..	..	9·25	·25
L'pool Overh'd Rly.	,, 12	2,761	— 175	..	..	..	3·8	4·2
Mersey Railway	,, 11	3,966	+ 289	..	..	..	4·5	..
Metropolitan Rly.	,, 12	31,567	+ 88	..	..	..	24·5	..
Met. District Rly.	,, 11	17,644	+1,614	..	..	..	24	..
†Anglo-Argentine	,, 7	18,778	+ 891	52	895,776	+81,870	48	..
§Auckland	Dec. 31	11,367	+1,554	52	187,719	+ 8,019	19·2	·58
§Brisbane	Dec.	15,890	+1,829	..	..	..	..	..
§Brit. Columbia Rly.	Nov.	37,375	+11,302	22	167,944	+48,363	6·8	4·2
†Buenos A. & Belgr'o.	Dec. 31	4,664	— 129	52	202,200	+10,282	..	..
Calcutta	Jan. 11	6,970	+1,851	..	..	..	..	..
§Geneva	Nov.	7,583	+ 321	..	..	..	..	..
Madras	Dec. 31	1,352	+ 167	52	27,783	+ 4,554	13·75	·5
Perth (W.A.)	Jan. 10	3,273	— 996	..	..	..	25·6	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

FURTHER progress is being made with the advance of prices amongst the investment markets. The Bank Rate reduction of January 2nd is sure to be followed by another fall this month, possibly within the next day or two. Borrowers offering high class stocks of various kinds have rushed into the market with their wares, to such an extent as to raise indignant protest from those who want prices to settle down. However, the securities with which we deal are affected only indirectly by these new issues of gilt-edged securities, and a good many rises have again—with much pleasure—to be recorded.

Home Railway stocks move with considerable irregularity. There is steady buying of the prior-charge descriptions, the Debenture, Preference and similar stocks, and the improvements are very well held. The Ordinary stocks, however, fluctuate a good deal, though rather tending to be better, on the whole. Central Londons maintain their rise, but City and South London slipped back a point. The new through bookings between these companies should be of service to both. The dividend declarations may come any day now. Great Northern and City Preferred soon lost their 5s. advance.

Metropolitan Consolidated drooped to 42½, after being lower, and Districts fell to 10½.

Attention has been called to the group of "Tube" stocks by the much better character of the traffics. At this season of the year the underground lines ought, of course, to be doing well, but the expansion in receipts obviously shows that the public have begun to appreciate the facilities offered by the network of intercommunicating lines.

Quotations for the Companies' 4 per cent. Debenture stocks are quiet, and have not responded much to the improved conditions. Bakerloo Debenture at 91 carries the 2 per cent. interest just due. Great Northern and Piccadilly Debenture at 81½ is recently *ex* the interest, while Charing Cross and Euston Debenture stands at 74½; the Company is doing less well than its seniors. Underground Profit-sharing notes remain about 37.

Last week's half score of rises in the electricity supply market has been succeeded by twice that number of gains. Nor has there been a single fall during the fortnight: the decline in Urban Preference is nominal, not real at all. Demand runs principally upon the shares in the London undertakings. Westminster Ordinary and Charing Cross Preference take the lead with rises of 10s. each. Most of the other shares of the chief Metropolitan Companies are 5s. better, and the Debenture stocks display slight improvements here and there.

The welcome change in prices, after the so long frost-bitten aspect of the electricity supply market, was started by a very retail amount of buying on behalf of those who considered that this depressed section would reap much benefit from easier monetary conditions. Directly the dealers saw a little demand, they raised prices all round, because it is fair to assume that not many people will want to sell, while conceivably the first batch of buying orders might encourage some others.

Electric Construction Preference are 5s. better, consequent upon the strength of the supply market, and other manufacturing issues keep firm. Westinghouse Preference, however, weakened again. British Aluminium shares continue to recover, and the 6 per cent. "A" Preference are over par again, at 5½. Willans & Robinson Ordinary at 25s. have improved, and Crompton's rose to 1⅛.

In the Telegraph division, the outstanding changes are rises of 7 in Mackay Companies' Common, and 3 in the Preferred stocks. These movements, of course, reflect New York changes, and the prices fluctuate in accordance with the parities cabled from the other side of the Atlantic. Cuba Telegraphs are good, both kinds being 5s. better, while Direct United States and Western Telegraph shares hardened to the same extent. Anglo-American Telegraph Deferred, however, suffered on profit-taking sales. West Coast of America shares are appreciably harder, while Great Northerns shed their fraction. Globe Telegraph Ordinary rallied 2s. 6d., and the Preference 7s. 6d., on account of the general rise in the securities owned by the company.

National Telephone Preferences are good. The unfortunate Marconi shares are down to half a sovereign. Tramway issues have varied little. Argentines are good, Calcuttas weaker, and London United Preference a trifle harder. Madras Tramway Debenture rose to 96½, and gains have been scored by the stocks of the San Paulo Tramway, and the Mexican Tramway Companies.

The Bank Rate.—The Bank Rate was yesterday reduced to 5 per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 7th.	Closing Quotations Jan. 14th.	Business done week ended Jan. 14th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2 — 3	2 — 3	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	84 — 87	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¾%	7¼%	7¼%	8 %	107 —110	107 —110	..	..	..	7 5 6
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	86 — 88 xd	86 — 88	..	..	..	4 10 11
660,660	Anglo-American Telegraph	Stock	61s.	2½%	3½%	3½%	57 — 60	57 — 60	57	..	..	6 9 2
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	100 —102	100 —102	101¼	100¾	..	5 17 8
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	¾%	1¾%	16½— 17½	16 — 16½	17 1/16	16 7/16	— ⅜	10 12 1
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6¾— 7¼	6¾— 7¼	..	..	..	5 10 4
2,097,680	Commercial Cable Sting. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84 xd	83	..	..	4 15 3
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6¼— 7¼	6¼	..	+ ¼	6 17 11
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15 — 16	15½— 16½	..	..	+ ½	6 8 1
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3¼— 3½	3¼— 3½	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼— 8½	8¼— 8½	..	..	..	6 5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	97 —100 xd	97 —100	..	..	..	4 9 0 0
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	13½— 14	13¾— 14½	14½	13¾	+ ½	6 6 10 9
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	130 —135	131 —136	133½	132	+1	5 2 11
2,000,000	Do. 8½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83 — 86	83 — 86	84½	84	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	101¼	100	..	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅝— 12¾	12¾— 13	12⅝	12¼	+ ⅛	5 7 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99½—102½	99½—102½	102¼	100½	..	3 18 1
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 8
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	15 17 0
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	5½%	9½— 10	9⅝— 10⅛	10	9⅝	+ ⅛	5 7 4
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	12⅝— 13⅛	12⅝— 13⅜	13 3/32	12 15/16	+ ⅛	4 9 9
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	15 %	24 %	24%	20 %	30½— 32½	30 — 32	..	..	— ½	6 0
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55	52 — 55	54½	54	..	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	53 — 58	60 — 65	..	..	+7	5 7 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	60 — 65	63 — 68	..	..	+3	5 17 8
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	8/9	..	— 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	¾— 1	¾— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 - 112	111½	110½	..	5 7 2
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	107½—109½	107½—109½	108⅝	107½	..	4 11 4
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾— 12¾	11 — 13	..	..	+ ½	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5 3/16	5⅛— 5¼	5 1/16	5¼	+ 1/16	4 13 0
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	96¼	..	..	3 11 5
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98 —100	99 —101	99¾	99½	+1	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¼%	6¼%	7 %	7 %	1 1/16— 1 1/8	1⅛— 1 1/8	22/-	..	..	5 17 11
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	5 1 1
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	96 —100	97 —100	..	..	..	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127	124 —127	124½	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6¾— 7	6¾— 7	..	..	..	5 14 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4½— 5½	4½— 5½	..	..	..	4 15 3
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	8 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1¼— 1⅜	1¼— 1⅜	25/-	..	+ ⅛	11 8 6
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	95 — 98 xd	96 — 99	..	..	+ ½	4 0 10
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	12⅝— 13⅜	12⅞— 13⅜	13⅜	12⅝	+ ¼	5 4 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	97 —100	97 —100	99½	..	..	4 0 0
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ½	⅜— ½	9/6	7/6	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7½— 7¾	7½— 7¾	7 13/16	7½	..	10 6 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	7⅛— 7⅜	7⅛— 7⅜	7¼	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	98 —101 xd	98 —101	..	..	..	4 19 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	..	8 %	8 %	8 %	7¾— 8¼	7¾— 8¼	8 1/32	7⅞	..	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5¼%	5¼%	5¼%	5¼%	5 13/16— 6 1/16	5⅞— 6⅛	6 1/16	5 13/16	+1/16	4 9 10
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	125 —128	125 —128	..	..	..	4 13 9
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	101 —104 xd	102 —105	104½	..	+1	4 15 3
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	20 %	3½— 3⅝	3½— 3⅝	82/6	72/6	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	3 16 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	2½— 4½	3½— 4½	81/3	80/-	..	7 15 7
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4½— 5	4½— 5½	5⅛	5 1/32	+ 1/32	6 13 4
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4½— 5½	4½— 5⅝	..	..	+ 1/16	5 11 8
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3½— 4½	3½— 4½	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	5 13 5
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	97 —100	97 —100	98	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	124 —127	125 —128	..	..	+1	4 13 9
900,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	105 —109	105 —109	..	..	..	4 11 9
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	101 —105	101 —105	99½	..	..	4 15 8
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	98 —101	99 —102	100½	100	+1	6 10 10
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1⅜— 1⅝	1⅜— 1⅝	33/6	27/6	+ ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	5⅛	..	10 18 2
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	90 — 93	90 — 93	92½	91½	..	5 7 6
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	69 — 74	69 — 74	..	..	..	6 1 7
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¼— 6⅝	6¼— 6⅝	6⅝	..	..	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅜— 1⅛	⅝— 1	..	..	— ⅛	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 48	40 — 50	41¼	40	..	8 6 8
50,000	‡Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	Nil	0— ¼	0— ¼	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	0 — ¼	0— ¼	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	¼— ⅜	¼— ⅜	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	63 — 66	63 — 66	..	..	—1	6 16 4
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4¼— 4⅜	4¼— 4⅜	..	..	—1/16	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅝— 5¼	4⅝— 5¼	98/11½	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅝— 5¼	4⅝— 5¼	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115 xd	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104 xd	101 —104	..	..	..	4 16 2
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	6⅜— 6¾	6¼— 6⅝	6½	6 5/8	— ⅛	5 18 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,830..	5			5 %	5 %	4⅝— 5⅛xd	4⅞— 5⅛	..	..	..	4 13 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	99 —103 xd	99 —103	..	..	..	4 7 5
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9½— 10½	9½— 10½	10½	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..	4 4 11
491,222	Cape El Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1¼— 1⅜	1¼— 1⅜	26/3	25/9	..	5 16 4
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	101—104	101 —104	..	..	..	4 6 7
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	65 — 68	65 — 68	67	65	..	5 17 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	84 — 86	85½	..	..	4 13 0
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	44 — 47	44 — 47	..	..	..	8 10 1
1,480,000	City and South London Railway	Stock	2½%	2½%	1¼%	2½%	45 — 47	41 — 46	45½	44	— ½	4 12 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 7th.	Closing Quotations Jan. 14th.	Business done week ended Jan. 14th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	* 3	2½%	2½%	2½%	5 %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	+ 1/16	8 6 8
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97 xd	94 — 97	..	..	..	5 3 1
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	%	6 %	6 %	6 %	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅜ — 13⅜	12⅜ — 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1/16 — 1⅛	1/16 — 1⅛	18/9	..	..	11 7 6
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	78 — 81	78 — 81	78	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1/16 — 1⅛	1/16 — 1⅛	20/7½	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	7⅞ — 8¼	7⅞ — 8¼	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1⅜ — 2⅛	1½ — 2	..	..	..	17 15 6
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅛ — 10⅞	10⅛ — 10⅞	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —106	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½ — 11½	10½ — 11½	11⅜	11	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	5 1/16	..	..	8 19 1
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104½—106½	104½—106½	106	..	..	4 4 6
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14⅛ — 15⅛	14½ — 15½	..	..	..	6 9 0
37,500	†Liverpool Overhead Railway, Ord.	10	1¾%	1¼%	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7¼ — 8⅛	7⅛ — 8⅛	..	..	+ ⅛	5 17 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	80 — 84	80 — 84	81	..	..	4 15 3
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 1/8	3/16 — 1/8	17/-	16/3	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	91 — 94 xd	91 — 94	..	..	..	4 15 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 3/16	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 1/4	1/16 — 1/8	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 18 9
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	28¼ — 30½	28¼ — 30½	29½	..	..	5 7 2
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —102 xd	99 —102	99½	..	..	3 18 5
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	34 — 37	35 — 39	..	..	..	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	⅜ — 1½	1 — 1½	..	..	+ ¼	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 3¾	3½ — 3¾	72/6	67/6	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	75	73¾	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	7⅞	7⅛	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅞	..	..	4 7 6
338,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 99	97 —100	..	..	+1	4 0 0
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3¾ — 4⅛	4⅛ — 4⅜	..	..	+ ¼	5 8 1
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅜	4⅜ — 5	87/6	86/3	+ ⅛	4 10 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½ xd	4⅜ — 4⅝	90/-	86/3	+ ⅛	4 12 4
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	96 — 99	..	..	+1	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3½ — 4¼	3⅝ — 4¼	76/3	73/9	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9⅜ — 10⅜	10 — 11	10⅜	..	+ ⅜	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11½ — 12½	..	..	+ ¼	4 18 0
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	120 —123 xd	120 —124	121	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	97 —100	99	96⅞	+2	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3¾ — 4¼	3¾ — 4¼	..	..	..	4 14 1
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¾ — 11	10¾ — 11	10⅛	10⅜	..	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	103 —106	103 —106	104½	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	¾ — 1⅛	¾ — 1⅛	21/3	..	..	10 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	70 — 80	70 — 80	..	..	..	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅛ — 5⅜	5 — 5½	..	..	+ ⅛	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅜ — 6⅞	6⅜ — 6⅝	..	..	..	6 10 11
21,000	Kensington and Knightsbridge Electric Ord.	5	12½%	12 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	+ ⅛	6 3 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	87 — 91	89 — 93	90½	..	+2	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	5⅜ — 6	5⅝ — 6⅛	6 1/16	5⅞	+ ⅛	6 8 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅝ — 5⅛	5	..	..	4 5 9
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	100 —104	100 —104	..	..	..	4 6 7
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	95 — 98	..	..	+1	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6⅛ — 6⅞	6⅛ — 6⅞	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¾%	7 %	7 %	7 %	5⅜ — 6	5⅜ — 6	5⅛	5⅞	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜ — 8⅛	7⅜ — 8⅛	8⅛	8	+ ⅛	5 17 8
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅜ — 7⅛	6⅜ — 7⅛	..	..	..	4 13 4
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	85 — 90 xd	85 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1⅛	⅛ — 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2⅜ — 3	2⅜ — 3	..	..	..	5 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1⅛ — 1⅜	24/-	..	+ ⅛	3 14 8
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	100 —103	101	..	+1	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	12 10 0
5C,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝ — 2⅜	2 — 2⅛	..	..	— ⅛	10 0 0
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	90 — 93	90 — 93	90⅜	..	..	4 16 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8 — 9	8¾ — 9⅛	9 1/16	8⅞	+ ⅛	6 6 4
81,979	Do. do. 4½ % Cum. Pref. (Original 5 %.—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4⅜ — 5⅛	5 — 5⅛	5 3/16	96/3	+ ¼	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 6 per cent. January 2nd. 1908.

ELECTRICAL EXHIBITS AT THE PARIS MOTOR-CAR SHOW.

(*Continued from page* 52.)

The G.E.M. Petrol-Electric Vehicles.—Considerable interest was shown in the new petrol-electric vehicles exhibited by the Société Générale d'Automobiles Electro-Mecaniques, of 11, Quai National, Puteaux, Paris, and built under the Auto-Mixte (Pieper) patents. The aim of the designer has been to produce a car which offers no encumbering levers, no troublesome speed-changing devices, no starting handle, no controlling organ—in fact, nothing but a steering wheel, and a lever thereon, and the clutch and brake pedals. The car is not on the usual lines of petrol-electric vehicles in which all the power generated is transmitted to the road wheels electrically; on the other hand, the electrical installation is intended as a substitute for the usual gear box, the power of the engine, when this is sufficient to drive the car, being transmitted direct to the rear live axle through a cardan shaft and bevel gear.

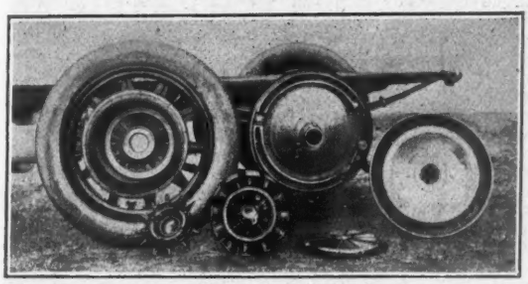


FIG. 12.—COMPONENTS OF MERCEDES ELECTRIC MOTOR WHEEL. (For description see page 52.)

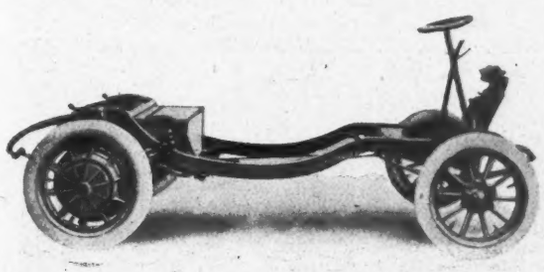


FIG. 13.—CHASSIS OF MERCEDES ELECTRIC CARRIAGE (See p. 52).

On starting the car, or on hills when the load is increased, and when usually it would be necessary on a petrol-car to drop to a lower gear, the extra power necessary is furnished by the accumulators and the dynamo-motor.

The arrangement of the car is briefly as follows:—A petrol engine drives a shunt-wound dynamo keyed on to the main shaft.

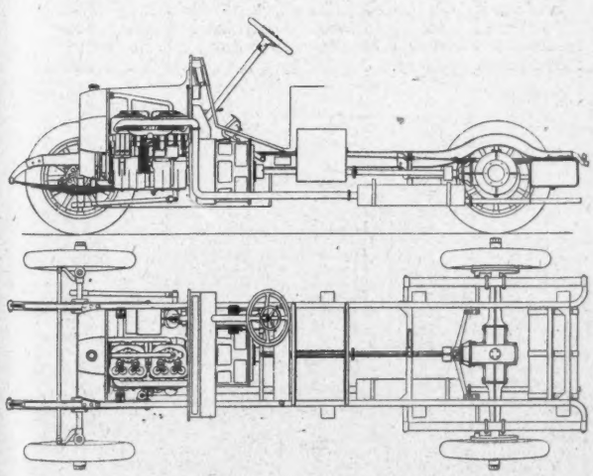


FIG. 14.—ELEVATION AND PLAN OF G.E.M. PETROL-ELECTRIC CAR.

The dynamo works as a motor or generator according as the E.M.F. is inferior or superior to that of the battery. In the first case it produces an excess of power; in the second it absorbs the excess power supplied by the engine. The battery is always maintained in a state of charge by the dynamo, and serves, beyond its *rôle* of reserve power, for the automatic starting of the engine, for the clutch and the brake, for the ignition, for the lighting, and any other accessory services, such as foot warmers, electric signals, &c. The petrol engine is of 24 H.P., and comprises four cylinders with mechanically-operated valves. The carburettor is of the usual automatic type, and is provided with an ingenious electro-magnetic regulating device acting on the throttle valve (fig. 15); this consists of a soft-iron plunger connected through a spring and arm to the valve, and working in a solenoid with two windings, one of fine wire being shunted across the terminals of the battery, while the other—a series one—is placed in the circuit connecting the dynamo to the accumulators. On passing a current through the solenoid the plunger is attracted or released according to the direction of the current, this reversing—in the series winding—according to whether the accumulators are discharging or being charged. Through the shunt winding the current is always in the same direction. Thus, when the battery is discharging, the engine throttle is opened proportionately, while as the accumulators are recharged, the admission of gas to the motor is reduced.

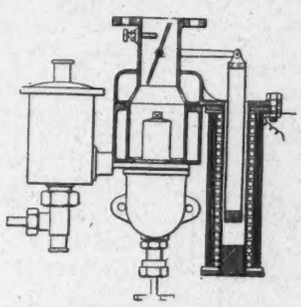
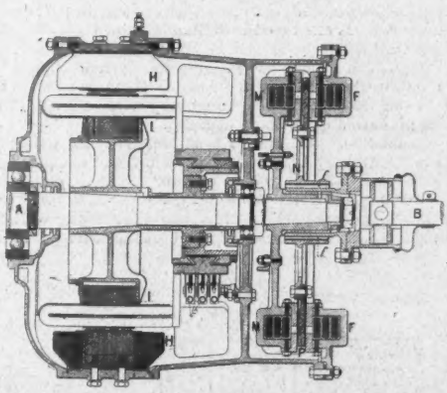


FIG. 15.—CARBURETTOR WITH ELECTRO-MAGNETIC REGULATOR ON G.E.M. CAR.

The rotary speed of the engine is limited to that imposed by the dynamo, which it drives; the crown of the electro-magnetic clutch, which serves also as a fly-wheel to the engine, is keyed, like the armature, on the end of the engine shaft (fig. 16). The result of this direct coupling is that the engine never runs at an angular speed above that which corresponds to the speed of the car itself. The dynamo is of the four-pole type, with series drum winding and shunt excitation, and is provided with auxiliary commutation poles with series excitation, which allows the brushes to be placed in a neutral zone and assures a good commutation, even with intense currents and a feeble field, without sparking.

The use of auxiliary poles allows of the variation of the angular speed of the dynamo, by simple shunt variation alone, between 400 and 1,600 R.P.M., the same as that of the engine which drives it. The battery consists of 24 Tudor cells connected in series, and



A, Engine crankshaft; B, Cardan shaft to rear axle; F, Brake magnetic coil carrier; H, Field magnets; I, Armature; M, Clutch magnetic coil carrier; N, Clutch spider; P, Clutch ring; *f*, Bearings of clutch.

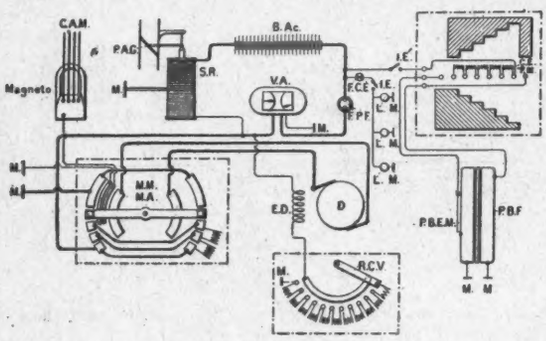
FIG. 16.—SECTIONAL VIEW OF GENERATOR-MOTOR AND ELECTRO-MAGNETIC CLUTCH AND BRAKE, ON G.E.M. PETROL-ELECTRIC CAR.

capable of giving 25 amperes for 45 minutes at 50 volts, it being specially designed to supply heavy currents without deteriorating.

Running in parallel, it thus adds its power to that developed by the petrol engine. The regulation of the latter is such that it works at full gas admission as soon as the battery gives out current and tends to discharge itself. After the assistance thus rendered the battery is automatically recharged with a current which diminishes in intensity as it approaches the state of complete charge, *i.e.*, as its E.M.F. increases.

One lever on the steering wheel serves for the starting and backward motion, while a second one controls the speed of the car

through the dynamo. The current controller constitutes, with the steering wheel and the clutch and brake pedal, one of the three organs necessary for the complete control of the car. The position 0 of the controller corresponds to all the circuits open. Passing from this to position "slow speed" produces successively:—(1) The closing of the exciting circuit of the dynamo on the battery without any external resistance; (2) the placing of the armature in connection with the battery with starting resistance in series, causing the petrol engine to run under the action of the electric motor; (3) the closing of the ignition circuit; and (4) the short-circuiting of the starting resistance. The successive positions from 2 to 12 correspond to increasing speeds, regulated by the excitation of the dynamo. In passing from one to the other, the entire car is accelerated, and for each period of acceleration energy is taken partly from the battery which drives the dynamo and engine, making it produce the complementary torque, and partly from the engine, of which the gas admission opens itself fully and causes it to produce its maximum power and thus relieve the battery. The



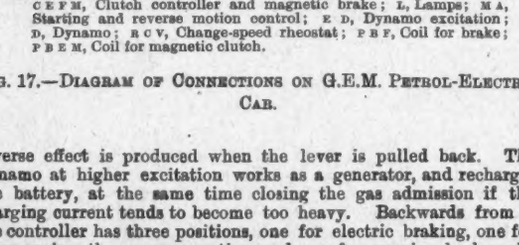
C A M, Engine ignition wires; M, Earth connection; S R, Solenoid controlling engine throttle; B Ac, Battery of accumulators; V A, Volt-amperemeter; F P F, Main switch and fusible plug; F C E, Lighting circuit fusible plug; I E, Lighting switch; I E', Clutch switch; C E F M, Clutch controller and magnetic brake; L, Lamps; M A, Starting and reverse motion control; E D, Dynamo excitation; D, Dynamo; R C V, Change-speed rheostat; P B F, Coil for brake; P B E M, Coil for magnetic clutch.

FIG. 17.—DIAGRAM OF CONNECTIONS ON G.E.M. PETROL-ELECTRIC CAB.

reverse effect is produced when the lever is pulled back. The dynamo at higher excitation works as a generator, and recharges the battery, at the same time closing the gas admission if the charging current tends to become too heavy. Backwards from 0 the controller has three positions, one for electric braking, one for commencing the reverse motion, and one for running backwards. All the electrical parts (excitation, ignition, clutch, brake and lighting) are designed to work normally at the voltage of the battery.

The electro-magnetic clutch and brake consists of an iron disk, the surfaces of which are face to face with crowns, also of iron, one of which—movable—is fixed on the prolongation of the dynamo shaft, the other being fixed to the frame. Each of these crowns has a magnetising coil in which passes an electric current of an intensity variable by the clutch and brake pedal. The adherence is in proportion to the current, which, being very weak at the beginning, allows the plate to slip on being engaged.

Only one model of pleasure car is at present being made; this is adapted to receive any type of carriage body, and is equipped with a 20-24-H.P. four-cylinder petrol engine, and a 10-H.P. dynamo-motor. A vehicle for industrial purposes is, however, also being produced, the power plant in this case comprising a 16-20-H.P. engine and a 7-H.P. dynamo-motor. Numerous advantages are claimed



A, Petrol engine; B, Dynamo; C, Controller; D, Motor; E, Pedal controlling forward and reverse motions and brakes; F, Speed-varying lever.

FIG. 18.—ELEVATION OF CHASSIS OF "LAVO" 24—30 H.P. PETROL-ELECTRIC CAB, SHOWING RELATIVE SIZES OF THE DIFFERENT PARTS.

for the system in the way of quiet running, efficiency, simplicity of control, &c., and the makers state that with an equal maximum power the chassis of the G.E.M. car is no heavier than that of an ordinary petrol car, the weight of the parts suppressed in the latter being equal to, if not more than, that of the dynamo and accumulators.

The "Lavo" Petrol-Electric Car.—Still another new petrol-electric car is that known as the "Lavo" (fig. 18), which is being made by La Société l'Energie Electro-Mecanique, a company which has large works at Rue Delaunay, Suresnes, near Paris. In these vehicles the motive-power is furnished by a four-cylinder set, as usual, in the fore part of the frame; built up with the fly-wheel is a dynamo, the current from which passes directly through the controller to the motor, no battery of accumulators being employed.

The feature of the "Lavo" system lies in the fact that only a single electric motor is employed, this being of the "differential" type—a machine which comprises two portions rotating in opposite directions and of which the resulting speed is the sum of those of the two parts. Each half of the motor is connected with one of the rear road wheels, rendering the use of the usual form of mechanical differential gear unnecessary. In addition to the saving in weight and the suppression of the differential, it is claimed that the use of a differential motor obviates all the drawbacks attendant on the employment of two electric machines, one for each road wheel. Instead of two collectors, there is only one, and consequently no accidents due to a short-circuit in one of the two motors usually employed need be feared. The motor is suspended in the frame by double-acting springs, in such a way that no shocks are transmitted to it when starting or braking the car. Starting and stopping, as well as the application of the brakes, is effected by a single pedal, the variations of speed being obtained by means of a lever on the steering wheel. A further lever is provided at the side of the driver by which he can control the forward and reverse motions by hand, as well as by the foot, or the lever may be securely fixed in a neutral position.

The system is being applied to industrial vehicles—delivery vans, lorries, omnibuses, &c.—as well as to pleasure cars; three models of the latter are being made, viz., 10-14 H.P., 16-20 H.P., and 24-30 H.P.; all are fitted with four-cylinder engines. As regards the transmission, the drive from the motor to the rear road wheels in the first two sizes is direct, while in the largest car, it is by chains. The chassis prices are respectively £380, £500, and £580.

(To be concluded.)

THE G.B. SURFACE-CONTACT SYSTEM.

(Abstract of a Lecture at East London College.)

AN interesting description of the G.B. surface-contact system of tramway traction was given by Prof. Morris, M.I.E.E., of East London College, in a lecture on December 19th. A line is being laid down in the Mile End Road that is to work on this system. Prof. Smith, of the same college, took the chair, and Mr. Bedell, the inventor of the system, was present.

Prof. Morris first gave a short introductory description of the different methods of tramway traction. The surface-contact system was decided upon by the L.C.C. because of the special conditions of the road. A railway runs beneath it, and does not leave sufficient depth for the conduit system. The overhead system was objected to by the borough authorities.

The G.B. surface-contact system was originally described in our issue of January 15th, 1904, and the tramways at Lincoln on this system were described in that of January 12th, 1906. It will be remembered that a magnetised skate carried by the car, but insulated from it, slides over a series of iron studs laid along the centre of the track. Each stud in succession is thus magnetised, with the result that a switch, connecting the stud to a live conductor that runs beneath, is closed. Current then flows through the stud and

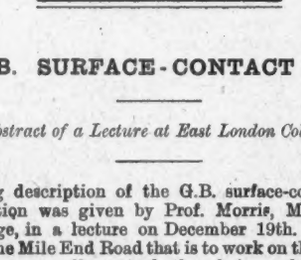


FIG. 1.

skate to the car. The rails are used for the return. A special feature of this system is the flexible skate, which allows the studs to be flush with the road surface. It is made up of a number of cast-iron links threaded upon a flexible cable, and supported by vertical springs so as to be 2 in. above the road surface. It lies along a slot in one pole of an electro-magnet. Three cores on which the

magnetising coils are wound connect to the other pole, which is above.

The magnets are excited by the main current through the motors. A battery in parallel with the windings supplies current when the car is standing, and is recharged while large currents are being taken by the motors.

The stud consists of an iron plate 10 in. long, from which two soft-iron cheeks project downwards. The plunger or switch piece is supported by a spiral spring between the two cheeks. It has a carbon block at the lower end, which, when the plunger is forced

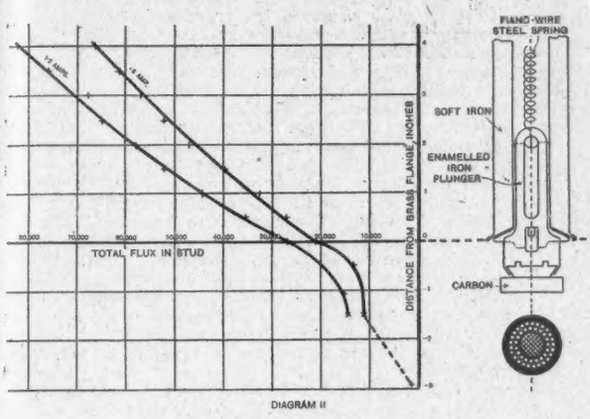


FIG. 2.

downwards by magnetic action, makes contact with a bare live conductor that runs beneath. The current flows from the plunger to the stud through flexible copper conductors, not through the spring, which is insulated, and is also thickly coated with copper to protect it against rust.

The cable is made up of a jute centre surrounded by a ring of copper wires. These are in turn surrounded by two rings of galvanised iron wire. Pieces of galvanised iron tubing, 6 in. long, are fitted over the whole. The conductance of this cable is equal to that of a 00 trolley wire. Heavier currents can be carried with the same total diameter by putting in more copper and less jute. The cable is drawn into earthenware piping, near the top of which it is supported by reel-shaped insulators, one at each stud. The insulators are threaded upon iron pins. One end of each pin projects outside the pipe, and these ends are connected together by hoop-iron. Electric osmosis, which otherwise would attack the cable, then acts upon the hoop-iron. The piping is carefully joined with tape and pitch poured inside an iron sheath, the joint being practically watertight. Any water that may leak in is carried away by drainage pipes. Alternate pipe lengths have an upward projection in which the stud fits. The two granite blocks that fit round the stud are hollowed out beneath the surface, and the cavity is filled in with pitch, which makes the joint between the stud and the pipe. The pipes are egg-shaped in section, and the depth required below the road surface is 16½ in.

The theory of the action of the plunger was gone into by Prof. Morris. He gave two explanations. The first considered magnetic poles, the second the complete magnetic circuit. We prefer the latter. If any part of a magnetic circuit is movable, it takes up such a position as to allow the maximum number of magnetic lines to flow. The magnetic circuit in this case is from the lower pole, which is made up of the magnet pole and the skate, to the stud and the conductor (if in position), and round through the air to the upper pole. The leakage surface is obviously greater with the stud out than in, therefore it moves out. The action, as confirmed by experiment, is much stronger with the cable in position than without it.

Fig. 1 shows the magnetic field of the stud with the plunger up and the plunger down. Fig. 2 gives the total magnetic flux through different parts of the stud, the 6 ampere curve giving working conditions; the combined section of the two soft iron cheeks is 1·2 sq. in. In fig. 3 the forces acting upon the plunger are plotted. The resultant force, as will be seen, is large at the commencement of the motion, with the result that the plunger moves sharply.

It is obvious that special provisions must be made at points and crossings, otherwise the skate would be attracted to the rail, and thus make a direct short-circuit. To prevent this, manganese steel rails are used. When steel is alloyed with 12 per cent. of manganese it becomes very nearly non-magnetic, and this property proves very useful in this case. An extra precaution is taken in the use of a special stud at these positions. In this stud the upper part is insulated from the lower part and connected to it through a resistance of 8 ohms, which limits the short-circuit current to 60 amperes.

Each car is fitted with apparatus for detecting a live stud. A brush carried by the car passes over the stud after the skate; if the stud is still alive the brush collects current that either rings a bell or opens the canopy switch. The driver, by driving his car slowly backwards, can then detect which stud is alive.

The only other example of the system is at Lincoln, where there is a line about 3 miles long. The London line differs from that at Lincoln in several ways. The studs are only 6 ft. apart instead of 9 ft. The shorter distance is the result of the requirement that the cars shall be able to be used on the conduit system also; the fittings for the plough only leave room for a comparatively short skate. The stalk of the stud is 1 in. shorter than that used at Lincoln.

The cost of installation of this system is 10 per cent. more than that of the overhead, whereas the conduit costs close upon double

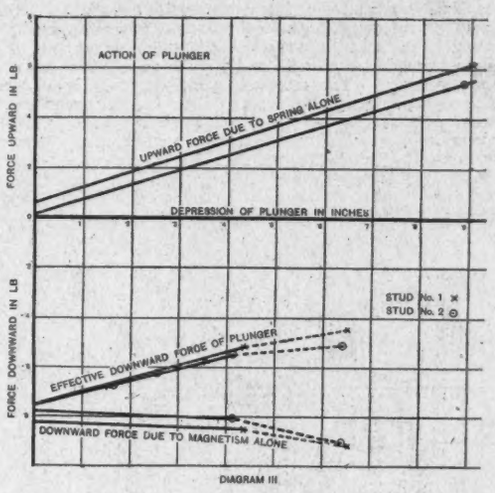

ACTION OF PLUNGER
UPWARD FORCE DUE TO SPRING ALONE
FORCE UPWARD IN LB
DEPRESSION OF PLUNGER IN INCHES
STUD No. 1 ×
STUD No. 2 ⊙
EFFECTIVE DOWNWARD FORCE OF PLUNGER
DOWNWARD FORCE DUE TO MAGNETISM ALONE
FORCE DOWNWARD IN LB
DIAGRAM III

FIG. 3.

As regards reliability and safety, we do not consider that there is much to choose between them.

The recording instruments used at Lincoln gave the mean drop across the battery and magnet windings as 25 volts. The tramway voltage being 500-550, this means that 5 per cent. of the total power is used in magnetising the skate. The resulting increase in running expenses will probably not amount to a great deal.

ELECTRICAL CASES IN 1907.

[FROM OUR LEGAL CONTRIBUTOR.]

IT is not unprofitable to pay some attention to the cases of electrical interest which have occupied the courts within the last 12 months. While the ordinary law reports contain a few cases which are chiefly of interest to the lawyer, it will be found that the columns of the REVIEW contain reports of many decisions of the highest practical importance. It is proposed to give a *résumé* of some of these.

The meaning of the term "complete installation" was considered in the case of Cort *v.* Holford (reported in the ELECTRICAL REVIEW, Vol. 60, pp. 181, 292). The plaintiffs quoted for the electrical part of an installation which was to be used for lighting a house in Essex. They were compelled to sue for the balance of their account. The dynamo, which was to charge accumulators, was to be worked by a 3-H.P. engine, which the defendant had in his possession. The plaintiffs agreed to provide a complete installation for a certain sum, the sum being made up of a number of items, including accumulators, switchboard and other fittings, but apparently not including a cut-out or shunt resistance. The main point in the case was whether a cut-out and a shunt resistance were necessary parts of a complete installation. If so, they could not be charged for as extras. It was contended on the part of the defendant that, given a good 3-H.P. engine, a cut-out and resistance were necessary. The plaintiffs, however, replied that when making their estimate they assumed that the engine was new; that if it had been new, a cut-out would not have been necessary, and that they were, therefore, justified in charging for a cut-out and resistance as extras. They also alleged that since the specification was made out the defendant had demanded an increase in the size of the battery. Had they known that the battery was to be larger, this would have influenced

their judgment in deciding whether to provide a cut-out. The learned judge decided this point in favour of the defendant, laying it down as a general principle that a cut-out and shunt resistance should always be supplied. He was not, apparently, impressed with the argument that the increase in the size of the battery would have affected the plaintiffs' judgment.

In a rating appeal on the part of the Coatbridge Electric Supply Co., Ltd., an important point as to the construction of the Lands Valuation (Scotland) Amendment Act, 1902, came up for consideration. The case is noted at some length in the Electrical Review for April 12th, 1907, at page 587. Our readers may remember that the Royal Commission on Local Taxation recommended, in 1901, that in estimating the rateable value of any hereditament, the value of no machinery except fixed machinery, or machinery used for first motor power, should be taken into account. Effect was given to this, so far as Scotland is concerned, by the Act above mentioned, which provides that "machinery fixed or attached" shall not include "machines, tools or appliances which are only so fixed that they can be removed from their place without necessitating the removal of any part of the building." In the case in question it was contended that certain electrical machinery and instruments, such as switchboards, generators and the like, also the electrical mains which were laid loose in pipes, came within the exception introduced by the Act, and were not comprised in the definition of "lands and heritages." The appellants also contended that there should be deducted (1) The estimated annual cost of repairs; and (2) The estimated annual contribution to a sinking fund necessary for the renewal of the machinery when worn out. On the other hand, the assessor maintained that estimated expenditure, which had not in fact been incurred, ought not to be taken into account in fixing the rent for the year. Lord Low (at the Court of Session) decided that the machines and appliances referred to, situate within the building of the "generating station," and which "are either loose or so fixed that they can be removed from their place without necessitating the removal of any part of the building," were excepted by the Act, but that the copper mains fell within the scope of the Act of 1902, and were "lands and heritages" for the purpose of valuation. He also held that the deduction should be the average annual amount which it might be expected that the tenant would require to expend in repairs and renewals, and not the present actual expenditure; and that an allowance of 10 per cent. upon the tenant's capital for interest and repairs and renewals of plant and machinery would fairly and adequately meet the requirements of the case.

The case of Lacey *v.* Otto Monster, Ltd., which is reported in the Electrical Review for March 15th, 1907, at p. 424, is an example of a type of case not infrequently met with—namely, a claim by electrical engineers for fees and a counterclaim for negligence. The alleged negligence consisted in faulty supervision of work erected. The plaintiffs were successful both on claim and counterclaim.

The case of Thorpe *v.* E. L. Berry, Harrison & Co. (reported in the Electrical Review, June 7th, 1907, at p. 921) raised a point of very great interest to electrical engineers and contractors. It appeared that the defendants' electrician was sent every quarter to test certain electric mains. For this purpose he had to visit the porter's lodge at Drydon Chambers, Oxford Street, where he gained access to the mains through a cellar flap. While he was at work, the steward of the chambers fell over the flap and was injured. He brought an action for damages against the firm. They alleged, and proved, however, that the porter at the chambers was in control and had opened the trap door; and that the accident arose solely through the negligence of the porter, a fellow servant of the plaintiff, in leaving the lodge during the progress of the work. After the case had been carried to the Court of Appeal, a County Court jury eventually found a verdict for the defendants.

In *re* Lord Leconfield's Settled Estates, which was heard by the late Mr. Justice Kekewich on May 28th, and is noted in the Review for June 14th, at p. 950, an interesting point arose under the Settled Land Acts. It was decided, in accordance with a well-established but somewhat absurd principle, that the Court has no power to authorise a tenant for life to expend capital moneys on the erection of an engine house for the engines which are to supply the mansion with electric light.

The case of Harper Bros. *v.* Biggs & Sons (reported in the Review for July 5th, 1907, at p. 7) may be referred to as an illustration of the fact that in reviewing a technical book it is not justifiable or in accordance with the law of copyright to publish long extracts therefrom, especially when they are made without any acknowledgment of the source.

Mention may be made of one other case (briefly reported in the Electrical Review for August 2nd, 1907, page 169) which raised a question as to the duty of a firm of accumulator manufacturers who undertake to maintain a battery of accumulators for a certain period. It appeared that, in 1901, the Committee of Visitors of an asylum in Manchester purchased a set of accumulators. A maintenance contract was subsequently entered into, whereby the company agreed that, for the payment of a certain premium, they would maintain the accumulators to a certain degree of efficiency for a period of 10 years. Printed working instructions were sent with the battery. These instructions referred, in particular, to the necessity for sometimes cutting out sick cells; but inasmuch as the cells were not connected together by screws, and could only be thrown out of circuit by cutting and re-turning the lead connections, it was alleged by the committee that the instructions were not applicable to the type of battery. In the summer of 1904 the battery failed to do what was required of it, and as the result of negotiation, the company eventually agreed to provide new negative plates. After this the battery worked well down to the spring of 1906, when complaints were made by the committee as to its defective working. It should be mentioned, however, that, in the summer of 1905, the company made inquiry as to whether the Committee had in their possession a booster or milking set which could be used for bringing up backward cells, and pointed out that they would not be responsible for the deterioration of the battery if this machine were not provided. They offered to supply one for £35. The Committee, however, refused to acknowledge any liability, stating that it was the duty of the company to supply the booster. Affairs having gone from bad to worse, the Committee finally dismantled the old battery, and sought to charge the company with the cost of a new one, and divers incidental expenses, the claim in all amounting to £1,200. The defendants paid £200 into Court, with a denial of liability. The case, which was heard by Mr. Pollock, Official Referee, last some 12 days, the sittings being held both at Manchester and in London. In the result the Referee found that, upon the true construction of the maintenance contract, the duty of supplying a booster was upon the company; that it was the company's duty to maintain the battery to the agreed state of efficiency, and that they had failed to do this. He was satisfied, however, that if a booster had been provided at the proper time, the life of the battery might have been prolonged. As soon as the Asylum Committee found that the company refused to provide a booster, they should have taken this necessary step themselves, and charged the cost to the company. They had no right to simply discard the old battery, and then charge the company with the amount of providing a new one. In the result he found that the plaintiffs could only recover, instead of £1,200, a sum of something under £200. That sum having been paid into Court, he gave judgment for the defendants.

The Draft Regulations: an Inquiry at Westminster.—From an announcement which appears in our advertisement pages to-day, it will be observed that an inquiry will be held at Caxton Hall, Westminster, on Tuesday, March 3rd, concerning the objections which have been lodged to the "Draft Regulations for the Generation, Transformation, Distribution and Use of Electrical Energy." Mr. James Swinburne is the Commissioner appointed to hold the inquiry.

The Farman Aeroplane.—All engineers will join in congratulating Mr. Henry Farman on his successful circular flight of nearly a mile, accomplished on Monday last in an aeroplane of his own design. The propeller was driven by an Antoinette 50-H.P. eight-cylinder engine of exceptional lightness. Mr. Farman, who is an Englishman, has thus won the Deutsch-Archdeacon prize of £2,000 and the grand gold medal of the Aero Club.

PROCEEDINGS OF INSTITUTIONS.

The Torque Conditions in Alternate-Current Motors.

By VAL. A. FYNN, Member.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS *at Birmingham, December 11th, 1907.)*

THE author deals with the torque conditions obtaining in some of the most important types of single and polyphase commutator and squirrel-cage or slip-ring motors, in a manner to bring out their several characteristic features, make it possible to compare the various types on a fair basis, and enable the formation of an opinion as to the relative degree in which the active material is, or can be, utilised in the several types, *i.e.*, as to their relative weight efficiency as distinct from their conversion or transformation efficiency, which is simply the ratio of output to input. The paper cannot be abbreviated without becoming unintelligible, and is too long to reproduce *in extenso*.

The author gives the following comparison between continuous and alternate-current motors:—It only remains, in conclusion, to establish a link between any one of the alternating-current motors which have been dealt with and the continuous-current motor, when the important question of the weight efficiency of the various alternating-current motors as compared with corresponding continuous-current machines can be readily deduced for any given case by the aid of the formulæ which have been given. In applying these formulæ it must be borne in mind that, as far as torque is concerned, it is not the maximum but the effective values of current and magnetic flux which are of importance. Now, in the case of the continuous-current machine, these effective values are equal to the maximum values, whereas this is not the case where alternate currents are concerned. The effective value of the alternate current, or that measured by our instruments, is directly comparable to a continuous current of the same magnitude, and there is no occasion to consider the maximum value of the alternate current, but the maximum value of the alternating flux *must* be considered. Assuming that the variations of the alternating current and flux follow a sine law, then the maximum value of the flux at any point will be $\sqrt{2}$ times greater than its effective value. It is this maximum and not the effective value of the alternating flux which determines the iron cross-section of the motor. It follows that if the same maximum flux density be allowed for the continuous-current and the alternating-current machine the latter must unavoidably be $\sqrt{2}$ times heavier for the same output as the "corresponding" continuous-current machine. By "corresponding" continuous-current machine is meant one in which the proportion of armature to field ampere-turns is the same as that of the alternate-current motor to which it is being compared; both machines operating with the same terminal voltage, yielding the same B.H.P. at the same speed, and working under the same general conditions. This increased iron cross-section necessitates more copper because the mean length of all the windings is thereby increased, so that one is not far wrong in saying that the alternating-current machine must be about 50 per cent. heavier than the "corresponding" continuous-current machine of the same output, the same maximum flux density, and the same copper section. Remembering that the continuous-current machine has only one effective armature and only one effective field axis per pole pair, it is at once seen that an alternating-current motor, such, for instance, as most of the single-phase motors, must be at least 50 per cent. heavier than the "corresponding" continuous-current motor, and that it is a physical impossibility to improve on this state of things unless the constants of the alternating-current machine are made very different from those of the continuous-current motor with which it is being compared, or *unless* the alternate-current motor is made with more than one effective armature and with more than one effective field axis per pole pair. If, for instance, the alternating-current motor is made with two effective armature and two effective field axes, as is the case with the two-phase motor, then the alternating-current motor will be at least 30 per cent. lighter than a continuous-current machine of the same output. In assessing the advantage of the two-phase motor over the continuous-current motor in point of weight at some 30 per cent., it must be borne in mind that this type of machine allows of a rather better utilisation of the active materials than is possible in the case of a corresponding single-phaser, the difference in favour of the two-phaser being some 10 to 15 per cent.

The foregoing deductions are broadly correct; they do not, however, take all the determining factors into account, but only give a limit. For a strict comparison each case must be treated separately, and recourse must be had to the formulæ which have been given. It should be remembered that the frequency for which the alternate-current motor is designed directly determines the permissible value of the total flux and of the maximum densities; down to about 15 cycles a reduction of the frequency generally means an increase of the weight efficiency of a commutator motor. It will also be clear from the foregoing that the flatter the wave of the alternate current in use, the better the weight efficiency of the motor. The effect of phase differences between the torque-producing factors, the effect of the power factor and the like, are all against the alternating-current machine. These disadvantages do not, however, always exist to the same degree; moreover, they are often counterbalanced, or even entirely outweighed, by weight advantages, such as the absence of commutators or even of slip-rings.

The successful design of continuous-current and alternating-current motors naturally follows widely differing lines, and this is why the weight efficiency of some of the alternate-current motors on the market can sometimes be increased beyond the limit given above, even in spite of the use of heavy commutators. Many considerations lead one, in the case of alternating-current motors, to the choice of lower magnetic densities and of a lower total flux than that which was adopted as a limit basis for the comparison which has just been made. The alternating-current machine is generally built with a greater number of ampere conductors per unit length of armature periphery than is deemed advisable in the case of continuous-current machines. Not the least amongst the determining factors for this course is the fact that iron losses present one of the greatest difficulties against which the alternating current designer has to contend, whereas C^2R losses are no more difficult to deal with in alternating-current than in continuous-current machines. Other important reasons for this tendency are the necessity of keeping the magnetising current low in the case of shunt motors, and correspondingly the necessity of reducing the reactance voltage of the field winding as far as possible in the case of series motors. The choice of a low total flux is also imperative in the case of commutator motors with a series characteristic, for it leads to a material improvement in the commutation. Every alternate-current motor must be neutralised, whether it has a powerful armature or not, whereas a neutralising winding is generally avoided in continuous-current machines. Its use certainly allows of the weight being reduced, but increases the cost.

Taking every factor into account, it may be stated as a basis for comparisons that the weight of a commercial continuous-current motor as compared to that of a commercial 50-cycle single-phase self-excited partly compensated shunt induction motor with slip-rings is as 1 : 1·5, and that the weight of the continuous-current machine as compared to a commercial 50-cycle two-phase partly compensated shunt induction motor with slip-rings is as 1 : 0·7. In cases where a commutator is used the weight is, of course, increased, but where such a commutator can be fully utilised in a rational manner, as is, for instance, the case with constant-speed machines, this increase in weight is fully compensated for by a correspondingly increased output. In other cases the use of a commutator leads to an increase in weight without a corresponding increase in output as in the case of motors with a series characteristic. This increase in weight is from 20 to 25 per cent., varying with the type of machine.

The difference in the design constants between commercial continuous and commercial alternate-current motors is most marked in the case of the continuous-current series traction motor as compared to the neutralised single-phase series conduction machine. The armature ampere-turns of the latter very greatly exceed those of the former in a motor of equal output and speed, with the result that the weight discrepancy between the two can often be reduced below the limit given, although this particular type of alternate-current motor requires a heavy commutator. Thus, with a current wave approximately following the sine law and a periodicity of 25 cycles; this alternate-current machine for the same heating need only be some 35 to 40 per cent. heavier than a continuous-current series motor of same output, speed and voltage.

It may be added that Prof. S. P. Thompson's "output coefficient" formula—$d^2 l = k \times$ KW./R.P.M.—yields very good results for all alternate-current motors. When the motor under consideration has more than one effective armature and more than one effective field axis per pole pair, then the value of k must be worked out separately for each pair of effective axes with the help of the formulæ here set forth, afterwards adding these values. Thus, in the case of a two-phase motor, for instance, we should write—

$$d^2 l = (k' + k'') \times \text{KW./R.P.M.}$$

By introducing one more constant, taking the mechanical features of a particular design into consideration, one arrives at very satisfactory weight curves for whole series of similar machines.

DISCUSSION.

DR. ALFRED HAY, in a written communication, said that Mr. Fynn's able paper would form a valuable supplement to his previous work on single-phase commutator motors. He regretted that Mr. Fynn dealt out but scant justice to other workers on single-phase commutator motors. The theory outlined on page 7, and said to be "perhaps most generally accepted," in his opinion, never had a single advocate. This imaginary theory was obviously the result of a superficial study of the contributions of others, and Mr. Fynn appeared to be the victim of a fallacy. In connection with such theories there were two methods of treatment available: The older method, involving the use of total (as distinguished from leakage) self-inductance and mutual inductance, which might be conveniently referred to as the hypothetical flux method, and the second method, adopted by the author and due to the late Dr. John Hopkinson, in which only the actually existing fluxes were considered. For this reason it might be termed the actual flux method. The relation between these two methods was in reality simple, as the actually existing fluxes were obtained by the superposition of the hypothetical fluxes. Dr. Hay then proceeded to apply the two methods to the case of the motor shown in fig. 1 of the author's paper, and showed that the hypothetical flux method led to conclusions identical with those arrived at by the author.

MR. R. ORSETTICH (General Electric Co.) said that he had had experience in constructing a single-phase motor of Mr. Fynn's design. It was designed so that it was possible to use the same patterns and tools as were used for standard polyphase motors. There was not a great demand for single-phase motors, and if such a motor required special patterns it was very much against it. He

did not believe in the single-phase motor when polyphase could be used. But there was a field for it, especially in connection with traction work. He believed that the large number of patents in connection with these motors had hindered their development. Other handicaps were the greater running costs as compared with polyphase motors, repairs to commutator and brushes and sparking. These difficulties had been overcome in the Fynn motor, and it did not require resistance or choking coils for starting. The starting windings were cut out at one operation in small motors, and in two or three steps with larger motors.

Mr. D. K. Morris (Coventry) said that there was in all electric motors, after all, only one belt of flux per pole which actually cut rotor conductors, and one belt of induced currents for each pole. In single-phase motors this belt fluctuated largely, while it revolved with the speed of synchronism. It was curious how, in dealing with the theory of electric motors, so little was said of the actual cause of their torque. The torque was due without exception to the pull and side-push of magnetic flux falling obliquely on the surface of the rotor, the obliquity arising solely from the "surface field" due to the rotor currents. Induced or inserted rotor currents produced a flux tangential to the rotor surface, and it was this which deflected the incident flux. If only one could get at the actual flux band, then the torque due to the currents it induced was at once obtained by methods which he and Mr. Lister had already pointed out. The rotor reaction shifted back the flux band, and the inductance of the bars still further shifted it in reality; but where the self-induction of the rotor and connections or external circuit was negligible, it was even true to say that the belt of rotor currents was always exactly below and proportional both in space and time to the true flux band of magnetic induction which really cut the rotor bars.

Dr. Gisbert Kapp said that Mr. Fynn had pointed out one of the motors described as being the best, saying that it was 30 per cent. lighter than a continuous-current machine of the same output. Was not this a two-phase motor? If so, it was a poor compliment to the single-phase motor, which was already heavier than the corresponding continuous-current motor of the same output. Prof. Kapp then asked the author's opinion as to the suitability of single-phase motors for traction purposes, and whether any of the motors described by Mr. Fynn had a nearly constant torque.

Mr. A. M. Taylor asked whether the author could give them any information as to the relation between torque and speed for single-phase traction motors.

Mr. Fynn, in reply, said that the whole theory was based on the simple fact that given an armature conductor carrying current in a magnetic field, then the result was a torque. It might be said that there was only one resultant field, and one resultant belt of current. But if one attempted to obtain a theory of the motor on these lines, in his opinion one would get nowhere. He had introduced the case of the two-phase motor, because he meant to deal with torque conditions generally. There was no doubt that the polyphase motor was superior to the single-phase in every respect. The chief advantage of the single-phase motor in connection with electric traction was an indirect one, due to the simplification of the line. He believed there would be no difficulty with regard to wheel skidding when using single phase motors, except when the frequency was reduced as low as about 15 cycles. The polyphase machine had an advantage over most single-phase motors in this respect, but the Winter-Eichberg motor was an exception, as it had two torques which did not coincide. The object of his paper was not to bring forward his own motor, but to get an idea of the working of all motors. In his opinion, the neutralised series-motor was the most efficient of the single-phase motors. Dr. Hay had found fault with his remarks in reference to a certain theory. If he had dealt out scant justice to his theory, it was certainly unintentional. The theory appeared in the *E.T.Z.* about May last. He had tried to understand it, but could not. Dr. Hay had attempted to explain this theory, and he could not understand the explanation either.

The Ratio of Heating Surface to Grate Surface.

An excellent paper on the above question was presented to the December meeting of the American Institute of Electrical Engineers.

Everyone knows that water-tube boilers have a much larger ratio of heating surface to grate surface than have, say, Lancashire boilers; but, in spite of this fact, their economy is no better, and many engineers say it is less. The author of this paper, Mr. W. S. Finlay, jun., discusses the results, on commercial and on steam-production lines, of the addition of a second grate under a boiler, and gives an illustration of a Babcock boiler to which such second grate has been added in respect of no fewer than eighteen of the boiler furnaces of the Fifty-Ninth Street station of the Interborough Rapid Transit Co. of New York City. The second furnace is much on the Dutch-oven type, which is now well established in America as one favourable to perfect cleanly combustion, and it is placed under the mud-drum end of the boiler, and the mud-drum is afforded protection by the over-arch of the furnace, the hot gases from which travel towards the boiler front under a tile baffle laid on the lower tubes, and mingle with the gaseous products of what may be termed the primary furnace. Both grates are of the sloping order, with hopper ash-dumping pits. The gases from the two furnaces make a pass upward through the bank of tubes into the triangular space under the drum, whence they pass downwards between the tubes and under a baffle extending down six of the fourteen rows, and away to the exit, the endeavour being made so to proportion the passage area as to compel the hot gases to leave no unswept areas of heating surface. The second grate has an area of 80 per cent. of the main grate. This was the most that could be got in. The results show that the commercial economy is good, and the steam economy is but little reduced. Curves of data and performance are given. One curve shows that for a draught of 0·5 in. of water the double furnace developed 1,100 B.H.P., as against 615 B.H.P. of the single furnace. This is but little less than the ratio of grate areas on which, let it not be

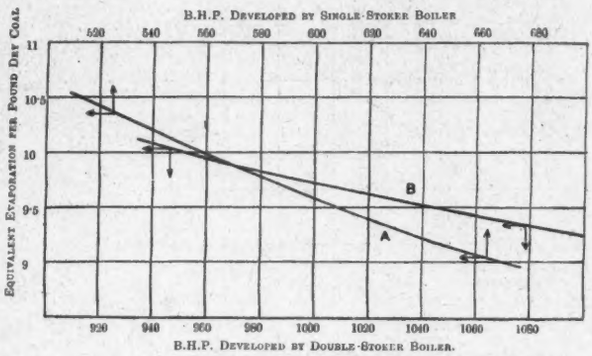

B.H.P. Developed by Single-Stoker Boiler
520 540 560 580 600 620 640 660 680
Equivalent Evaporation per Pound Dry Coal
11 10·5 10 9·5 9
B
A
920 940 960 980 1000 1020 1040 1060 1080
B.H.P. Developed by Double-Stoker Boiler.

Fig. 1.—Relative Values of Economical Evaporation and B.H.P. Developed.

forgotten that the extra grate reduces the ratio of radiation loss to total output by nearly a half. For a draught of 0·3 in. the two outputs were 550 and 965 B.H.P. respectively. With 0·55 in. of draught the double furnace gave a greater relative output than the grate area would *per se* indicate.

In the diagram of efficiency per pound of coal (fig. 1) the two boilers came out equal, when the evaporation, from and at 212° F., was nearly 9·9 lb. and the power developed nearly 570 B.H.P. and nearly 970 B.H.P. respectively. At lower powers the single furnace showed a better efficiency, and at greater powers the double furnace excelled. Also the double furnace gave the flatter curve showing more uniform action, and we cannot but think that much of this is due to a certain give and take between the furnaces or it may be due to the Dutch-oven construction.

Worked at equivalent economy of evaporation the double furnace boiler was equal to about 71 per cent. greater total output than the single furnace boiler, while, if the double furnace boiler was worked to an output proportionate to its grate area, the economical loss was only 2 to 3 per cent., an amount that may well be recouped

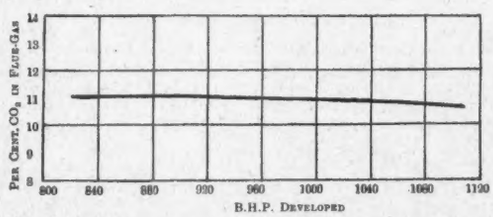


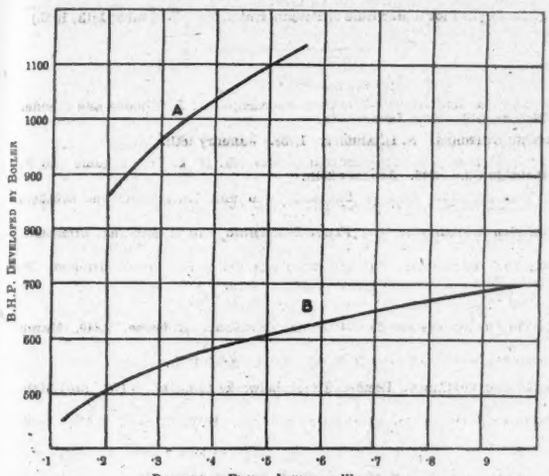
Fig. 2.—Variation of CO_2 in Flue-Gas with B.H.P. Developed (Double-stoker Boiler).

at the economiser. Practically, to summarise the results it may be said that 71 per cent. can be added to boiler output with no loss of fuel economy, and this, of course, means that boiler plant may be correspondingly reduced with all the attendant first cost of buildings, piping and other items. The author assumes a case of double grate area and shows 19·6 per cent. saving in first cost in a plant costing £25 per kw., and of 20·8 per cent. in a plant costing £30 per kw., while, of course, there would be savings in similar proportion on the annual charges, which will vary from 5·64 per cent. at 100 per cent. load factor to 9·65 per cent. at 4·16 per cent. load factor (365 hours per year). This for the plant costing £25 per kw. For the £30 per kw. plant the total plant charges vary from 7·06 per cent. saving at 100 per cent. load factor, to 11·51 per cent. at 4·16 per cent. load factor.

Obviously, therefore, if our author's figures can be relied upon to be fairly general in application this feature of grate area ratio to heating surface is entitled to very much more consideration than is usually allotted. But the paper is somewhat curiously incomplete. The areas of the two grates are given in ratios only, namely, 100 and 80. No areas are given. No data relative to coal consumption are afforded, so that nothing can definitely be said as to the number of heat units generated per unit of heating surface. Nor is the heating surface given. The primary grate appears to measure 10 ft. by 8 ft., and the evaporation appears to average about 10 lb. from and at for 560 H.P., but though something might be worked out from this, we are not told the heating surface, and much of the value of the paper is quite lost by these unfortunate omissions, and it is easy to come to wrong conclusions. We reproduce some of the diagrams which show the results. It is easy to believe that good results might attend upon the use of two furnaces mingling their products. The result would tend towards more steady temperature, to greater regularity of CO_2 percentage, and there would be greater facility

for well balanced stoking and perfect combustion. It cannot be told how much of the good results may arise from the Dutch oven second furnace, but it would be interesting to have all the data, so that a sound judgment could be come to, after knowing the evaporation per unit of heating surface and the rate of combustion.

It is highly probable that in many large power installations, boilers might be worked much harder than they often are worked, even at the cost of some little efficiency, for the gases would pass



A, Double-stoker; B, Single-stoker Boiler.

FIG. 3.—RELATION OF DRAUGHT AND OUTPUT.

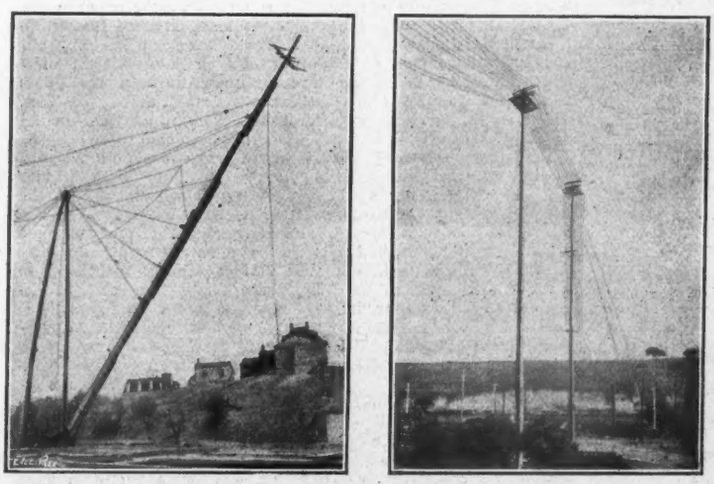
better to the economisers, and these could be placed two in series, so as better to reduce the gases in temperature, for it is rarely that the feed-water is ever heated so highly as it might be in the economiser. True, a heavily worked boiler may prime, but no good plant should lack a dryer or a superheater, and excessive priming should be dealt with by a suitable separator placed before the superheater where practicable.

Reinforced Concrete Towers.

By D. W. KRELLWITZ.

(*Abstract of paper read before* THE AMERICAN SOCIETY OF ENGINEERS, *October 2nd*, 1907.)

THE author describes the reinforced concrete towers built for the Lincoln Light and Power Co. on each side of the old Welland Canal, Ontario. These are 150 ft. high, 142 ft. from ground level; 11 in. square at the top, and 31 in. at the bottom. They are provided



REINFORCED CONCRETE TOWERS, DURING ERECTION AND IN POSITION.

with foot-steps and rungs. Each tower carries 16 No. 1 copper wires on glass insulators. The cross-arms are 10 ft. long, with a working platform under them, 5 ft. wide. The span over the canal is 76 ft., and adjacent to this there is a span of 300 ft. On one of the towers the wires run vertically, carried by frames 42 and 82 ft. from the top, and at the top there is therefore a heavy pull in the direction of the line. Wind pressures of 30 lb. per sq. ft. on flat surfaces, and 15 lb. per sq. ft. on cylindrical surfaces, have been allowed for, assuming that the wires are coated to a thickness of $\frac{3}{4}$ in. with ice. Without wires and guys, the towers were to withstand a pull of 2,000 lb. at the top; when erected and guyed, they were to be able to sustain the total pull of the wires with the 300 ft span broken, plus the full wind pressure on the tower.

Particulars are given of the method of designing the towers. The square cross-section, with four corner rods, was chosen, because this arrangement was more economical than any other.

While changing the guys on the tower carrying the vertical wires, the whole of the line pull came on the tower without guys; the maximum deflection at the top was about 2 ft., but no visible cracks appeared. The base consists of a cube of concrete 10 ft. wide, with 8 ft. of the tower within it, and an opening was left in one side to admit the foot of the tower during erection.

The moulds were made inclined, to save in erection. The concrete was composed of one part of Portland cement and five parts of the very best gravel, with sand, of which 36 per cent. would pass through a sieve of 0·2-in. mesh. Two wooden shear-legs were used in erecting the towers; this operation took place 38 days after moulding, but smaller towers have been erected successfully 14 days after moulding. It is suggested that these towers are the highest monoliths in existence at the present time.

The Faraday Society.

(*The Centenary of the Discovery of the Alkali Metals and the Industrial Developments of the Discovery.* By DR. F. MOLLWO PERKIN.)

ON November 19th, 1807, Davy delivered the Bakerian Lecture before the Royal Society, entitled "On some new Phenomena of Chemical Changes produced by Electricity, particularly the Decomposition of the fixed Alkalies and the exhibition of the new substances which constitute their bases; and on the general nature of Alkaline Bodies." The lecture contained two discoveries of first-rate importance, the successful application of a new method, and the isolation of new elements. Soda and potash, the so-called "fixed alkalies," till then supposed to be irreducible to simpler forms, were conclusively proved to contain metals combined with bases, and the method by which this result was obtained was to pass a strong electric current through the alkalies in a state of "igneous fusion." Some of Davy's own words are well worth quoting:—

"A small piece of pine potash, which had been exposed for a few seconds to the atmosphere, so as to give conducting power to the surface, was placed upon an insulated disk of platina, connected with the negative side of the battery,* in a state of intense activity; and a platina wire communicating with the positive side was brought into contact with the upper surface of the alkali . . . . Under these circumstances a vivid action was soon observed to take place. The potash began to fuse at both its points of electrisation. There was a violent effervescence at the upper surface; at the lower, or negative surface, there was no liberation of elastic fluid; but small globules having a high metallic lustre, and being precisely similar in visible characters to quicksilver appeared, some of which burnt with explosion and bright flame as soon as they were formed, and others remained and were merely tarnished, and finally covered by a white film which formed on their surfaces."

Davy called his new elements by the names which they have borne ever since, potassium and sodium, and he gave a remarkably accurate account of many of their physical and chemical properties. He also attempted to decompose the alkaline earths, and obtain what are now known as the metals calcium, strontium, and barium in the pure state; but this he did not succeed in doing, although he did obtain them, as well as magnesium, in the form of their amalgams. Bunsen, in 1852, first obtained magnesium in the pure state by the electrolysis of the fused chloride.

Not until the dynamo was perfected, and the generation of electricity on a large scale became an every-day matter, was there any chance of Davy's method attaining industrial importance, although in 1851 Charles Watt appeared to foresee its possibilities in the patent taken out that year for the electrolysis of fused sodium chloride, using Daniell cells as the source of current. Already in 1827, however, Wöhler manufactured potassium on a practical scale by reducing potassium carbonate with carbon, and in 1854 Sainte Claire Deville manufactured sodium by a similar method, and for a similar purpose—namely, the production of aluminium. The manufacture of sodium was actually carried on at Salindres, in France, for 30 years, nearly 6,000 kg. being annually produced. The manufacture of aluminium electrolytically, independently worked out by Hall and Héroult in 1886 and 1887, was really the first industrial application of Davy's method of electrolysing fused salts in the real sense of the term industrial, while, as far as the manufacture of the alkali metals themselves is con-

* The battery referred to contained 100 plates of copper and zinc 6 in. square, and 150 plates of copper and zinc 4 in. square, charged with solutions of alum and nitric acid—without, of course, porous partitions. The voltage was probably about 220, and the current under 1 ampere.

cerned, it was not until 1890, when Castner introduced his now well-known method for making sodium by the electrolysis of fused sodium chloride, that Davy's own experiments were first repeated on a practical scale. Since that date development has been rapid and continuous, and many cleverly designed processes for electrolysing all the metals of the alkalies and the alkaline earths are now in use all over the world. The possibilities of the method have by no means been exhausted, and the time will probably come when not only these, but many other metals and alloys will also be produced by fused electrolysis, and seeing that the fundamental practical difficulties have already been overcome in the case of lead and zinc, it can only be a matter of time and favourable economic opportunity for the method discovered by Davy to become one of the chief weapons in the armoury of the metallurgist.

At the same meeting on Tuesday, December 17th, at which Dr. Perkin discussed Davy's work, a well-worked out paper by J. T. Barker, on "A Physico-Chemical Study of the Complex Copper-Glycoll Sulphates," was read by Prof. F. G. Donnan. The paper deals with the constitution of the blue solution formed when glycocoll is added to copper sulphate solution, the combination being of considerable physico-chemical interest from the fact that a reduction takes place in the number of copper ions present, complex cupu-glycocoll kations appearing to be formed in their place.

NEW PATENTS APPLIED FOR, 1908

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

5,564A. "Concatenated control of alternating-current motors." R. D. MERSHON. (Date applied for under Rule 13, March 7th, 1907.) January 1st. (Complete.)

2. "Improved electric portable lamp." T. SHEPHERD. January 1st.

12. "Resistance for controlling electric current." N. R. BOOTH. January 1st.

16. "Improvements in telephones." N. D. PHILLIPS. January 1st.

35. "Improved electrical pattern for the manufacture of jacquard cards." P. WEISSENBORN. January 1st. (Complete.)

53. "Improved method of connection of detectors of receiver systems." S. EISENSTEIN. January 1st. (Complete.)

57. "Improvements relating to electric motors." H. A. MAVOR and MAVOR AND COULSON, LTD. January 1st.

58. "Improved method for obtaining variable self-induction." S. EISENSTEIN. January 1st. (Complete.)

66. "Improvements in arc lamp electrodes." G. M. LITTLE. (Date applied for under Section 91 of the Act, January 5th, 1907, being date of application in United States.) January 1st. (Complete.)

72. "Improved apparatus for the production of undamped electrical vibrations." S. EISENSTEIN. January 1st. (Complete.)

79. "Electro-magnetic apparatus for determining the hardness of paramagnetic metals. J. KRYLOFF and P. SCHIMUNEK, (trading as Paul Grosch, succs. Schimunek & Co.). January 1st. (Complete.)

93. "Improvements in and relating to automatic electric switches or cut-outs." G. F. MANSBRIDGE. January 1st.

104. "Improvements in electric lamp fitting." C. M. ESCARE, P. F. ESCARE and C. DAMEY. January 2nd.

105. "Improved secondary battery." P. SCHREIBER. January 2nd.

112. "Improvements in or relating to magneto-electric machines." H. W. VAN RADEN. January 2nd.

136. "Improvements relating to electric lamp and shade holders for oil lamp reservoirs." A. H. ENTWISTLE. January 2nd.

143. "Improvements relating to sparking plugs for internal combustion engines." R. B. RANSFORD. (Société Anonyme Montbarbon, France.) January 2nd. (Complete.)

153. "Improvements in trolley poles." J. SHEPPERD and F. B. ULLERY. January 2nd. (Complete.)

155. "Improvements in electro-magnetically operated regulating or switching apparatus." O. RENNERT. January 2nd. (Complete.)

156. "Improvements relating to recording meters of electromotive force and current strength." J. SEABROOK. January 2nd.

157. "Improvements in or connected with apparatus for the transmission and reception of electrical or electro-magnetic oscillations or vibrations." E. O'TOOLE. January 2nd.

174. "Apparatus for the automatic control of engines, trains or trams, both steam, electric or any other description, to be worked in connection with special apparatus for the purpose of working the automatic control." W. F. BLADON. January 3rd.

177. "Improvements in apparatus for controlling electric motors." J. H. HINDLE. January 3rd.

197. "Improvements in switching apparatus for interconnecting the lines of a telephone exchange system." J. E. KINGSBURY. (The Western Electric Co., United States.) January 3rd.

201. "Improvements in electric lamps for use by divers." R. H. DAVIS. January 3rd.

220. "Improvements in selective electric signalling." A. H. NICHOLSON. January 3rd. (Complete.)

268. "Improved method of strengthening electric vibrations." S. EISENSTEIN. January 4th. (Complete.)

286. "Improved sender connections for wireless telegraphy or telephony." S. EISENSTEIN. January 4th. (Complete.)

290. "Improvement relating to multiple switches, particularly applicable to automatic telephone exchange selectors." SIEMENS BROS. & CO., LTD. (Siemens & Halske Akt.-Ges., Germany.) January 4th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1906.

PROCESS FOR PREPARING PRINTING PLATES BY MEANS OF ELECTROLYTIC ETCHING. H. Strecker-Aufermann. 28,319. December 12th.

MANUFACTURE OF METAL ARTICLES BY ELECTRO-DEPOSITION. S. O. Cowper-Coles. 18,126A. June 6th. (Date applied for under Rule 5 of Patent Rules, 1905, December 5th, 1906.)

METHODS OR MEANS OF ELECTRIC BRAKING. G. H. Babb, F. T. Chapman and E. H. Cockshott. 28,739. December 17th.

METHOD OF AND MEANS OR APPARATUS FOR PRODUCING METALLIC INCANDESCENCE BODIES FOR ELECTRIC GLOW LAMPS. Deutsche Gasgluhlicht Akt.-Ges. (Auerges.) 28,775. December 17th. (Date applied for under International Convention, March 27th, 1906.)

ELECTRIC IGNITION FOR INTERNAL COMBUSTION ENGINES. W. J. Crossley and J. P. Jackson. 28,846. December 18th.

ELECTRO-DEPOSITION OF IRON. S. O. Cowper-Coles. 28,897A. December 18th. (Date applied for under Rule 5, Patents Rules, 1905, December 18th, 1906.)

1907.

COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES. A. L. Rhodes and Rhodes Motors, Ltd. 316. January 5th.

ELECTRIC SWITCHES. A. L. Ambler. 1,958. January 18th.

GRAVITY ESCAPEMENTS AND ELECTRIC CLOCKS. H. H. S. Cunynghame and F. Hope-Jones. 1,945. January 25th.

OVERLOAD ELECTRIC CIRCUIT BREAKERS AND THE LIKE. Siemens Brothers Dynamo Works and C. R. Palairet. 2,227. January 29th.

ELECTRICAL GENERATORS FOR FLOUR-BLEACHING AND SUBSIDIARY PURPOSES. F. H. Loring. 3,724. February 15th.

ELECTRICAL DISTRIBUTION SYSTEMS WITH THE AID OF STORAGE BATTERIES. H. Wuillot and A. Feron. 4,172. February 19th.

ELECTRIC TELEGRAPHY. I. Kitsee. 6,280. March 15th.

ELECTRIC FUSE-BOXES AND FUSE-HOLDERS THEREFOR. R. Gross. 6,849. March 21st.

ELECTRO-MECHANICAL TOYS. H. Ruhl. 8,838. April 16th.

SAFETY ELECTRIC CABLE. Land-und Seekabelwerke Akt.-Ges. 9,176. April 19th. (Date applied for under International Convention, August 3rd, 1906.)

TELEPHONE SYSTEMS AND APPARATUS THEREFOR. H. R. Turner. 9,833. April 27th.

FITTINGS FOR GAS, ELECTRIC AND OTHER LIGHTS. M. Stern. 10,887. May 9th.

ELECTRIC CONDUCTORS. O. T. Hungerford. 11,123. May 13th.

END PIVOTS FOR THE SPINDLES OF ELECTRIC METERS. Allgemeine Elektricitäts Ges. 13,074. June 5th. (Date applied for under International Convention, March 14th, 1907.)

SYNCHRONISING APPARATUS FOR DYNAMO-ELECTRIC MACHINES. P. MacGahan. 16,514. July 18th. (Date applied for under International Convention, July 26th, 1906.)

MAGNETIC ORE SEPARATOR. G. W. Lundberg and A. G. Holmberg. 16,675 July 20th.

OPERATIVE SYSTEM ELECTRIC LOCOMOTIVES. O. Bohm. 18,498. August 15th.

DOUBLE WIRE OVERHEAD ELECTRIC TROLLEY SYSTEMS. K. Von Kando. 18,798. August 20th.

DYNAMO-ELECTRIC MACHINES. Allgemeine Elektricitäts Ges. 22,404. October 10th. (Date applied for under International Convention, October 22nd, 1906.)

Electrolysis by Alternating Currents. — J. L. R. Hayden has conducted some interesting experiments on the effects of alternating currents in dilute saline solutions, and in solutions mixed with soil, imitating in this manner the conditions actually found in the earth. In the earliest experiments it was demonstrated that little or no interest attached to materials made of iron, and the later experiments were conducted entirely with sheets of lead, which were carefully weighed before and after the experiments. These were immersed in the conducting material and submitted to the action of the current for a period varying from 60 to 400 hours. Blank experiments were conducted as a check on the chemical action, independent of the current. The salts used were those usually found in the soil, such as nitrates, carbonates and chlorides. The frequency varied from 25 to 60 cycles, and the current density from 0·008 to 0·002 ampere per square centimetre. With saline solutions alone the results arrived at may be briefly summed up as follows:—Corrosion is greatest with nitrates. With other salts it is a curious fact that where the chemical activity is greatest the electric corrosion is least. The effects of current density are by no means certain. As a rule, a low frequency causes the largest amount of corrosion, but this also is by no means an invariable rule. Mixed salts frequently cause a very low chemical action, but a large amount of electrical disintegration. In the preliminary experiments with various soils, it was soon established that the loss due both to chemical and electrical causes differs very little with widely different types, and in nowise compares with the results obtained with purely saline solutions. The addition of lime and gypsum to the soil exercises a protective influence on the plates, but this disappears on the addition of saline solutions. Gypsum alone protects the plates when a current of 60 cycles is employed, but this influence is reversed when only 25 cycles are in use. Organic matter in the soil increases the corroding effect greatly, and in such a case, lime and gypsum make it still greater. With Portland cement the chemical action is very great, but on the other hand, the electrical action is small. As before, the disintegration of the metal increases as the frequency falls, but here, again, the introduction of some salts into the soil has a marked action on the results. Gypsum is remarkable in this respect, in that the rate of corroding is increased six-fold by decreasing the frequency from 60 to 25 cycles. Portland cement, on the other hand, greatly reduces this effect. Nitrates in the soil greatly increase the rate of corrosion, but many carbonates reduce it, and this protective influence is most pronounced in the case of the alkali metals. This desirable result is, however, greatly modified in the presence of other salts.—*Revue d'Electrochimie et d'Electro-Metallurgie.*